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(54) **Marine Transfer System**

(57) A marine transfer system (1) for securing a marine vessel (2) to a structure (4), the marine transfer system (1) comprising: a platform assembly (6) configured to carry personnel and/or materials; a bumper member (8) configured to contact the structure (4); a gripping assembly (10) configured to selectively engage the structure (4) to secure the marine transfer system (1) to the structure (4); a gangway assembly (18) configured to carry personnel and/or materials; and a support assembly (20) configured to support the gangway assembly (18)

and permit vertical movement with respect to the marine vessel (2). The gripping assembly (10) is further configured such that when an upward force is applied to the platform assembly (6), the gripping assembly (10) is able to slide upwards with respect to the structure (4) and when the upward force is not applied to the platform assembly (6), the gripping assembly (10) grips the structure (4) and prevents downwards movement of the gripping assembly (10) with respect to the structure (4).

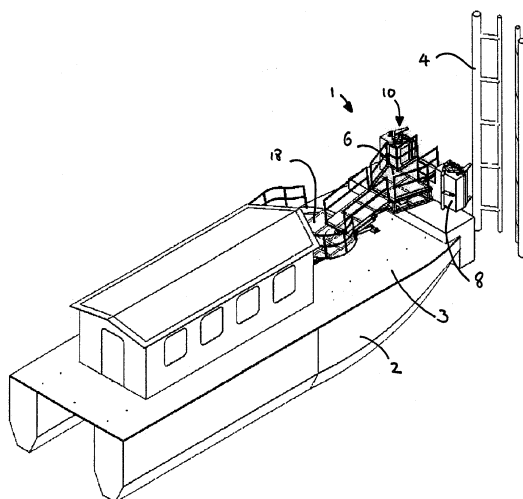


Figure 1

Description

[0001] This disclosure relates to a marine transfer system and method and particularly, but not exclusively, relates to a marine transfer system for transferring personnel and/or materials between a marine vessel and a structure.

Background

[0002] The transfer of personnel and materials from a marine vessel to other structures, such as offshore wind turbines, is an important consideration for the offshore industry. In particular, there are a number of factors to consider when determining the safety and the efficiency of the transfer, especially in adverse weather conditions. As such, transferring personnel and/or materials from the marine vessel to the structure is one of the most hazardous operations undertaken during the construction and maintenance of an offshore wind turbine.

[0003] Transfer of personnel and materials occurs on a regular basis after the initial installation as part of the servicing/maintenance of the turbine and personnel may be required to carry heavy loads from the marine vessel to the structure. The mast of the turbine has access ladders for personnel to climb onto from the marine vessel as a means of reaching the nacelle, where the turbine mechanisms, gearboxes and generators are housed. Currently there is a risk of personal injury and material damage as the personnel involved must judge the safest time to step from the front of the marine vessel to the rungs of the ladder on the mast as the marine vessel moves about in the sea.

[0004] Moreover, there exists an operating window outside of which the safe transfer of personnel and/or materials is not possible. Currently, the marine vessels used for transfer purposes must satisfy the UK MCA Small Commercial Vessels Code. This means that in seas above 1 m (sea state 3 on the Beaufort scale), which is a common occurrence, the vessels do not provide enough stability to allow personnel to safely step from the vessel to the ladder on the mast of the turbine. As weather conditions worsen, the increased rotational (pitch, roll and yaw) and translational (sway, heave and surge) motions of the vessel reduces safety even further. As such, the operational window in which maintenance/servicing is possible becomes heavily dependent upon weather conditions.

[0005] A known procedure for personnel and/or materials transfer is to engage the marine vessel against a structure on the mast of the turbine and apply a large amount of thrust to maintain engagement with the structure. However, legislative policies, such as The Energy Efficiency Design Index (EEDI) and the Ship Energy Efficiency Management Plan (SEEMP), are driving for a reduction in the overall emissions generated by marine vessels. It is undesirable therefore to sustain prolonged periods of full throttle in order to maintain engagement

of the marine vessel with the structure. Hence, current marine vessels are specifically designed to be small and lightweight, to reduce emissions and to allow the vessel to attend to several turbines within the operating window. For this reason, there are specific constraints regarding the size and weight of a marine transfer system for a marine vessel.

[0006] The offshore wind industry is currently implementing the use of marine vessels to service and maintain the current (Phase 2) wind turbines. However, the next stage of wind turbines (Phase 3) to be installed around the coast of the UK and elsewhere will be in deeper water with larger swell (sea state 5 on the Beaufort scale) and further offshore than the Phase 2 turbines. This provides further restrictions on the operating window in which a marine vessel and its transfer system must operate.

[0007] It is known to provide a marine transfer system for a marine vessel that allows for the transfer of personnel and/or materials to a structure during adverse weather conditions. However, such systems are often heavy, large and expensive as they implement hydraulic/robotic mechanisms with complex feedback systems. See for example US2011/0038691 A1 and GB2480408 A. Furthermore, as such systems are mounted to the front of the marine vessel, the visibility from the cabin of the marine vessel may be significantly impaired when using current marine transfer systems.

[0008] The present invention therefore seeks to address these issues.

Statements of Invention

[0009] According to a first aspect of the present invention there is provided a marine transfer system for transferring personnel and/or materials between a marine vessel and a structure. The marine transfer system is configured to secure the marine vessel to the structure. The marine transfer system comprises a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system comprises a bumper member coupled, for example movably coupled, to the platform assembly, other components of the marine transfer system and/or the marine vessel. The bumper member is configured to contact the structure. The bumper member may be movable relative to the platform assembly between a first position and a second position. The marine transfer system comprises a gripping assembly. The gripping assembly comprises one or more gripping elements, for example latching elements, coupled to the bumper member. The gripping elements are configured to selectively engage the structure to secure the marine transfer system to the structure. The gripping assembly comprises a force transfer mechanism that operatively connects the bumper member to the gripping elements. The force transfer mechanism is configured to actuate the gripping elements from an open position, in which the marine transfer

system is not secured to the structure, to a closed position, in which the marine transfer system is secured to the structure. The force transfer mechanism may be actuated upon movement of the bumper member from the first position to the second position.

[0010] The marine transfer system may comprise a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system may comprise a support assembly configured to support at least a portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly and/or the gangway assembly. The support assembly may be configured to permit vertical movement of at least a portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly and/or the gangway assembly, with respect to the marine vessel. The support assembly may comprise a winch assembly. The support assembly may comprise one or more cables coupled to the support assembly and/or the gangway assembly. The cables may be wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of at least a portion of the marine transfer system, for example the gangway assembly, the platform assembly, the bumper member and/or the gripping assembly, with respect to the marine vessel.

[0011] The gripping assembly may be configured to couple the platform assembly to the structure. The gripping assembly may be configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure. The gripping assembly may be configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure. The upward force may be applied to the platform assembly by virtue of the upward force acting on the marine transfer system and/or the marine vessel.

[0012] According to a second aspect of the present invention there is provided a marine transfer system for transferring personnel and/or materials between a marine vessel and a structure. The marine transfer system comprises a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system comprises a support assembly configured to support at least a portion of the marine transfer system, for example the gangway assembly. The support assembly is configured to permit vertical movement of at least a portion of the marine transfer system, for example the gangway assembly, with respect to the marine vessel. The support assembly comprises a winch assembly. The support assembly com-

prises one or more cables coupled to the support assembly and/or the gangway assembly, the cables being wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of at least a portion of the marine transfer system, for example the gangway assembly, with respect to the marine vessel.

[0013] The marine transfer system may comprise a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system may comprise a gripping assembly configured to couple the platform assembly to the structure. The gripping assembly may comprise one or more gripping elements. The gripping assembly may be configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure. The gripping assembly may be configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure. The upward force may be applied to the platform assembly by virtue of the upward force acting on the marine transfer system and/or the marine vessel.

[0014] The marine transfer system may comprise a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system may comprise a bumper member coupled, for example movably coupled, to the platform assembly. The bumper member may be configured to contact the structure. The bumper member may be movable relative to the platform assembly between a first position and a second position. The marine transfer system may comprise a gripping assembly. The gripping assembly may comprise one or more gripping elements coupled to the bumper member. The gripping elements may be configured to selectively engage the structure to secure the marine transfer system to the structure. The marine transfer system may comprise a force transfer mechanism that operatively connects the bumper member to the gripping elements. The force transfer mechanism may be configured to actuate the gripping elements from an open position, in which the marine transfer system is not secured to the structure, to a closed position, in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

[0015] According to a third aspect of the present invention there is provided a marine transfer system for transferring personnel and/or materials between a marine vessel and a structure. The marine transfer system is configured to couple a marine vessel to a structure. The marine transfer system comprises a platform assembly con-

figured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system comprises a gripping assembly configured to couple the platform assembly to the structure. The gripping assembly comprises one or more gripping elements. The gripping assembly is configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure. The gripping assembly is configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure. The upward force may be applied to the platform assembly by virtue of the upward force acting on the marine transfer system and/or the marine vessel.

[0016] The marine transfer system may comprise a bumper member coupled, for example movably coupled, to the platform assembly. The bumper member may be configured to contact the structure. The bumper member may be movable relative to the platform assembly between a first position and a second position. One or more of the gripping elements may be coupled to the bumper member. One or more of the gripping elements may be configured to selectively engage the structure to secure the marine transfer system to the structure. The gripping assembly may comprise a force transfer mechanism that operatively connects the bumper member to the gripping elements. The force transfer mechanism may be configured to actuate the gripping elements from an open position, in which the marine transfer system is not secured to the structure, to a closed position in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

[0017] The marine transfer system may comprise a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure. The marine transfer system may comprise a support assembly configured to support at least a portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly and/or the gangway assembly. The support assembly may be configured to permit vertical movement of at least a portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly and/or the gangway assembly with respect to the marine vessel. The support assembly may comprise a winch assembly. The support assembly may comprise one or more cables coupled to the support assembly and/or the gangway assembly. The cables may be wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of the gangway assembly with respect to the

marine vessel.

[0018] According to the first, second and third aspects of the present invention the marine transfer system for transferring personnel and/or materials between a marine vessel and a structure may comprise any of the additional features as set out below.

[0019] The marine transfer system may be coupled, for example movably coupled, to the marine vessel, for example the marine transfer system may be secured to a deck and/or a hull of the marine vessel, and/or any other appropriate part of the marine vessel. In this manner, when the marine transfer system is coupled to the marine vessel, the bumper member of the marine transfer system may be movable relative to the marine vessel, for example movable relative to the marine vessel between the first position and the second position. The bumper member may be movable relative to the support assembly, for example movable relative to the support assembly between the first position and the second position. The bumper member may be movable relative to the gangway assembly, for example movable relative to the gangway assembly between the first position and the second position.

[0020] The bumper member may be configured to carry personnel and/or materials between the marine vessel and the structure. The bumper member may comprise one or more platforms. The bumper member may comprise one or more railings, for example hand rails.

[0021] The bumper member may be slidably coupled to the platform assembly. The bumper member may comprise a resilient member configured to deform upon contact with the structure. The bumper member may comprise a first biasing mechanism configured to bias the bumper member towards the first position of the bumper member. The first biasing mechanism may comprise one or more first spring elements configured to move the bumper member from the second position of the bumper member to the first position of the bumper member.

[0022] The structure may be part of a wind turbine, an offshore platform, a harbour wall or part of another marine vessel.

[0023] The force transfer mechanism may comprise a hydraulic, pneumatic, mechanical and/or electronic system. For example, the movement of the bumper member may be transmitted fluidically, mechanically and/or electronically, e.g. via one or more sensors and one or more actuators. The force transfer mechanism may be selectively activatable. The force transfer mechanism may selectively actuate the gripping elements independently from the movement of the marine vessel and/or the marine transfer system. The force transfer mechanism may be configured to lock the gripping elements, for example in the open position and/or in the closed position.

[0024] The platform assembly may be configured to engage the gangway assembly.

[0025] The gangway assembly may be configured to engage the platform assembly and/or a deck of the marine vessel. The gangway assembly may be coupled, for

[0031] The gripping assembly may comprise a gripping mechanism configured to adjust a gripping force of the gripping elements. The gripping mechanism may comprise one or more pneumatic, hydraulic and/or electro-mechanical devices configured to actuate the gripping elements. The gripping assembly may comprise one or more sensing devices configured to determine the motion of the boat and provide a signal to the gripping mechanism. The gripping mechanism may at least partially comprise the force transfer mechanism, i.e. the gripping mechanism may be provided as part of the force transfer mechanism such that the one or more sensing devices may be configured to provide a signal to the force transfer system for the purpose of adjusting the gripping force of the gripping elements. The gripping force of the gripping elements may be adjusted to allow the gripping assembly to slide upwards with respect to the structure.

[0034] The support assembly may comprise one or more support members configured to support the gangway assembly on the marine vessel. The support assembly may comprise first and second support members each comprising first and second ends. The first ends of the first and second support members may be coupled, for example pivotably and/or slidably coupled, to the gangway assembly and the second ends of the first and second support members may be coupled, for example pivotably and/or slidably coupled, to the deck of the marine vessel. The first and second support members may be pivotably and/or slidably coupled together at a point between their respective first and second ends. The support members may be configured to engage the force transfer mechanism. The support members may be coupled, for example rigidly or movably coupled, to the force transfer mechanism. The first and/or second end of the first support member may be coupled to the force transfer mechanism. The first and/or second end of the second support member may be coupled to the force transfer mechanism. The force transfer mechanism may be configured to connect the first end of the first support member and/or the first end of the second support member to another portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly, the gangway assembly and/or the support assembly. The force transfer mechanism may be configured to connect the second end of the first support member and/or the second end of the second support member to a portion of the marine vessel, for example the deck and/or the hull of the marine vessel. The force transfer mechanism may be at least partially disposed between the first end of the first support member and/or the first end of the second support member and another portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly, the gangway assembly and/or the support assembly. The force transfer mechanism may be at least partially disposed between the second end of the first support member and/or the second end of the second

support member and another portion of the marine transfer system, for example the platform assembly, the bumper member, the gripping assembly, the gangway assembly and/or the support assembly.

[0035] At least one of the support members may comprise two or more movably coupled support member portions. One or more of the support members may be extendable, for example the support members may be extendable support members each comprising two or more support member portions configured to slide relative to one another. The support members may be telescopic, for example the support members may comprise two or more concentrically arranged support member portions configured to slide relative to one another. The support members may each comprise one or more sliding linkages, for example a guide rail and follower member arrangement, configured to permit the support member portions of each support member to slide relative to one another. The force transfer mechanism and/or another force transfer system, for example another hydraulic system, may be configured to selectively actuate one or more of the support members, for example cause the support member portions to move relative to one another.

[0036] The position of the support member portions of the support member may be lockable relative to one another, for example the support members may be lockable at a predetermined length. The support members may be configured to extend and/or contract by a predetermined amount depending upon the operational requirements of the marine transfer system. The support members may comprise a locking mechanism, e.g. a locking pin, configured to lock the position of the support member portions relative to one another. The locking mechanism may be actuated by the force transfer mechanism and/or another force transfer system, for example another hydraulic system. The marine transfer system may comprise a sensor, for example a pressure sensor or force transducer, configured determine the loading on the marine transfer system, for example the loading on the support assembly, as a result of the engagement between the marine vessel and the structure. The locking mechanism may be actuated depending upon the magnitude and/or direction of the loading on the marine transfer system, for example the locking mechanism may be engaged so as to lock the relative positions of the support member portions under one loading condition, e.g. when the marine vessel and the structure are not in engagement and/or until the loading on the marine transfer system, for example the loading on the support assembly, reaches a predetermined level.

[0037] The marine transfer system may comprise one or more coupling elements, e.g. pulleys and/or guides, provided on points of the marine transfer system. The points at which the coupling elements may be provided on the marine transfer system may be movable with respect to the marine vessel. The coupling elements may be provided on points of the platform assembly. The coupling elements may be provided on points of the bumper

member. The coupling elements may be provided on points of the gripping assembly. The coupling elements may be provided on points of the gangway assembly. The coupling elements may be provided on points of the support assembly.

[0038] The support assembly may comprise one or more coupling elements, e.g. pulleys, provided on points of the support assembly such as the support members. The points at which the coupling elements are provided on the support assembly may be movable with respect to the marine vessel. The one or more cables may be coupled to the one or more coupling elements. The coupling element may comprise a pulley wheel or guide. The cable may be wound one or more times around the coupling element. The one or more cables may be configured such that a first point of the cables connected to the winch assembly and a second point of the cables connected to the winch assembly, a further winch assembly or an anchor point. The tension force in the one or more cables may provide structural rigidity to the support assembly. Further coupling elements may be provided at other points on the marine vessel, e.g. on the deck.

[0039] According to a further aspect of the present invention there is provided a method of transferring personnel and/or materials between a marine vessel and a structure. The method comprises: engaging a marine transfer system with the structure; gripping the structure with a gripping assembly of the marine transfer system to secure the marine transfer system to the structure; permitting upward movement of the gripping assembly with respect to the structure; preventing downward movement of the gripping assembly with respect to the structure; and supporting a gangway assembly of the marine transfer system, the gangway assembly at one end being operatively connected to the gripping assembly and being configured to carry personnel and/or materials between the marine vessel and the structure.

[0040] The method of transferring personnel and/or materials between the marine vessel and the structure may further comprise: de-gripping the structure; disengaging the marine transfer system from the structure; and lowering the gangway assembly towards the deck of the marine vessel.

List of Figures

[0041] For a better understanding of the present disclosure, and to show more clearly how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 shows a marine transfer system for a marine vessel in an unengaged configuration with a structure;

Figures 2a and 2b show a platform assembly, a bumper member and a gripping assembly of the marine transfer system in an unengaged configuration

with the structure;

Figures 3a and 3b show the platform assembly, the bumper member and the gripping assembly of the marine transfer system in an engaged configuration with the structure;

Figure 4 shows an embodiment of the gangway assembly and support assembly for the marine vessel in a first supported position;

Figure 5 shows the embodiment of the gangway assembly and support assembly for the marine vessel in a second supported position;

Figure 6 shows a further embodiment of the gangway assembly and support assembly for the marine vessel in a first supported position;

Figure 7 shows another embodiment of the gangway assembly and support assembly for the marine vessel in a first supported position;

Figure 8 shows the another embodiment of the gangway assembly and support assembly for the marine vessel in a second supported position;

Figure 9 shows the platform assembly and a gripping assembly for the marine vessel in a first position relative to the structure; and

Figure 10 shows the platform assembly and a gripping assembly for the marine vessel in a second position relative to the structure.

Detailed Description

[0042] A marine transfer system 1 according to an example of the present invention is shown in figure 1. The marine transfer system 1 is suitable for securing a marine vessel 2 to a structure 4, such as an offshore wind turbine, for the purpose of transferring personnel and/or materials from the marine vessel 2 to the structure 4 in a safe and efficient manner.

[0043] The marine transfer system 1 comprises a platform assembly 6 configured to carry personnel and/or materials and may comprise a platform, a framework and/or railings. In the example shown in figures 1, 4 and 5, the platform assembly 6 is configured to engage a gangway assembly 18. The platform assembly may however be configured to engage a deck 3 of the marine vessel 2 or any other appropriate structure and/or device.

[0044] The marine transfer system 1 comprises a bumper member 8 that is movably coupled to the platform assembly 6. The bumper member 8 is configured to contact the structure 4 and is movable relative to the platform assembly 6 between a first position and a second position. In the example shown in figures 1 to 7, the bumper

member 8 is configured to slide relative to the platform assembly 6, e.g. by virtue of protruding portions 7 that are free to slide in receiving portions 9. The bumper member 8 may however be configured to move relative to the platform assembly 6 by any other appropriate means.

[0045] The marine transfer system 1 comprises a gripping assembly 10, comprising one or more gripping elements 12 configured to selectively engage the structure 4 for the purpose of securing the marine transfer system 1 to the structure 4. In the example shown in figures 1 to 7, the gripping elements 12 are pivotably coupled to the bumper member 8 or in an alternative arrangement they may be coupled by any other appropriate means. In the example shown in figures 2a to 3b, the gripping assembly comprises two pairs of gripping elements vertically spaced apart from each other. Each pair of gripping elements 12 is configured to engage a first and second portion of the structure 4. The gripping elements 12 may comprise jaw/hook members configured to engage the structure 4. The gripping elements 12 may be configured to exert a lateral force on the structure 4 such that the lateral force applied to the first portion of the structure 4 is balanced by the lateral force applied to the second part of the structure 4, i.e. the net lateral force applied to the structure 4 by a pair of gripping elements 12 is substantially zero.

[0046] The gripping assembly 10 further comprises a force transfer mechanism 14 that operatively connects the bumper member 8 to the gripping elements 12. The force transfer mechanism 14 is configured to actuate the gripping elements 12 from an open position to a closed position upon movement of the bumper member 8 from the first position to the second position. In the example shown in figures 1 to 7, the force transfer mechanism 14 comprises a hydraulic system but may comprise any other appropriate system that is configured to actuate the gripping elements 12 consequent to the movement of the bumper member 8. The force transfer mechanism 14 may comprise one or more hydraulic pistons 14a configured to be actuated by the movement of the bumper member 8 relative to the marine vessel 2.

[0047] Figures 2a and 2b show the marine transfer system 1 with the bumper member 8 in the first position and the gripping elements 12 in the open position. As the marine vessel 2 approaches the structure 4, the bumper member 8 contacts the structure 4. The bumper member 8 may comprise a resilient member 16 configured to deform upon contact with the structure 4. Further movement of the marine vessel 2 towards the structure 4 causes the bumper member 8 to slide from the first position to the second position, i.e. towards the platform assembly 6. As the bumper member 8 slides from the first position to the second position, the force transfer mechanism 14 converts the movement of the bumper member 8 to movement of the gripping elements 12, causing the gripping elements 12 to move, e.g. pivot, from an open position to a closed position.

[0048] Figures 3a and 3b show the marine transfer sys-

tem 1 engaged with the structure 4. The structure is gripped between the bumper member 8 and the gripping elements 12. The bumper member 8 is in the second position and the gripping elements 12 are in the closed position in which the marine transfer system 1 is secured to the structure 4. The gripping elements 12 may be configured to not interfere with any feature of the structure 4, e.g. a supporting element 4a of the structure 4, in a way that may cause damage to and/or impair the function of the structure 4 and/or gripping elements 12 as the gripping assembly 10 grips the structure.

[0049] The force transfer mechanism 14 may comprise a release system to allow the gripping elements 12 to return from the closed position to the open position and therefore permit the marine transfer system 1 to disengage the structure 4. The release mechanism may be operated by personnel on the platform assembly 6 and/or remotely from the marine vessel 2 and/or the structure 4. For the example where the force transfer mechanism 14 comprises a hydraulic system, the release system may comprise a pressure release valve.

[0050] The bumper member 8 may comprise a first biasing mechanism configured to bias the bumper member 8 towards the first position. The first biasing mechanism may comprise one or more first spring elements, or any other appropriate mechanism, that act to move the bumper member 8 from the second position to the first position. Thus, the first biasing mechanism may be configured to cause the gripping elements 12 to move from the closed position to the open position upon movement of the bumper member 8 from the second position to the first position. In this manner, the gripping assembly 10 is reset upon disengagement from the structure 4.

[0051] The gripping assembly 10 for the marine transfer system 1 as presently disclosed secures the marine vessel 2 to the structure 4. As such, the marine vessel 2 need only apply low amounts of thrust to keep the marine vessel 2 engaged with the structure 4, which reduces the overall emissions produced during the transfer of personnel and/or materials between the marine vessel 2 and the structure 4. Furthermore, the gripping assembly 10 requires no further power once engaged with the structure 4, which maximizes the overall efficiency of the marine transfer system 1.

[0052] The marine transfer system 1 further comprises the gangway assembly 18 configured to carry personnel and/or materials. The gangway assembly 18 may be configured to engage the platform assembly 6 and/or the deck 3 of the marine vessel 2. The gangway assembly 18 may be pivotably and/or slidably coupled to the platform assembly 6 and/or the deck 3 of the marine vessel 2. The gangway assembly 18 may comprise one or more gangways 17, 19 and in the example shown in figures 1, 4 and 5, the gangway assembly 18 comprises a first gangway 17 and a second gangway 19. The first gangway 17 may be coupled to the second gangway 19 such that the first and second gangway 17, 19 may articulate relative to each other. The second gangway 19 may be

provided to the side of the cabin 5 of the marine vessel 2 as shown in figures 4 and 5. Consequently, the weight of the marine transfer system 1 is more evenly distributed along the deck 3 of the marine vessel 2, thereby reducing the weight acting at the bow of the marine vessel 2. The gangway assembly 18 may be foldable into a collapsed position on the deck 3 of the marine vessel 2 when not in use.

[0053] The marine transfer system 1 further comprises a support assembly 20 configured to support the gangway assembly 18 and permit vertical movement of the gangway assembly 18 with respect to the marine vessel 2. The support assembly 20 may comprise one or more support members 22 configured to connect the marine vessel 2 to the gangway assembly 18.

[0054] In the example shown in figures 1, 4 and 5, the support assembly 20 comprises first and second movable, elongate support members 22a, 22b, but in an alternative arrangement the support members 22a, 22b may have any other shape or form. The support members 22a, 22b have first ends 22a', 22b' coupled to the gangway assembly 18 and second ends 22a'', 22b'' coupled to the deck 3 of the marine vessel 2. The first ends 22a', 22b' of the first and second support members 22a, 22b may be pivotably and/or slidably coupled to the gangway assembly 18, e.g. the first and second gangways 17, 19 respectively. The second ends 22a'', 22b'' of the first and second support members 22a, 22b may be pivotably and/or slidably coupled to the deck 3 of the marine vessel 2. The first and second support members 22a, 22b may be pivotably and/or slidably coupled together at a point between their respective first and second ends 22a', 22a'', 22b', 22b'', e.g. by virtue of a bearing 23 provided in slots 25a, 25b in the first and second support members 22a, 22b.

[0055] In the example shown in figures 1, 4 and 5, the first end 22a' of the first support member 22a is pivotably and slidably coupled to the gangway assembly 18 and the second end 22a'' of the first support member 22a is pivotably coupled to the deck 3 of the marine vessel 2. The first end 22b' of the second support member 22b is pivotably coupled to the gangway assembly 18 and the second end 22b'' of the second support member 22b is pivotably and slidably coupled to the gangway assembly 18.

[0056] It is appreciated, however, that the support assembly 20 may comprise any number of support members 22 configured to couple the gangway assembly 18 to the deck 3 of the marine vessel 2. For example, the arrangement of the support members 22 as shown in the present example may be duplicated on a plane in front of or behind that shown in figures 4 and 5, such that the gangway assembly 18 may comprise a double support assembly 20 arrangement.

[0057] The support assembly 20 may comprise one or more coupling elements 24 provided on points of the support assembly 20. In the example shown in figures 1, 4 and 5, the support assembly 20 comprises a plurality of

coupling elements 24 provided on movable points of the support assembly 20. The coupling elements 24 are provided at the ends of the support members 22, although it may be appreciated that the coupling elements 24 may be provided at any point on the support assembly 20.

[0058] The support assembly 20 comprises a winch assembly 26 and one or more cables 32. The one or more cables 32 are coupled to the support assembly 20 and/or the gangway assembly 18 and wound round the winch assembly 26 so that the winch assembly 26 is operable to adjust the length of unwound cable 32 for the purpose of maintaining a tension force in the cable 32 in order to permit the vertical movement of the gangway assembly 18 with respect to the marine vessel 2.

[0059] The winch assembly 26 may comprise one or more sensors configured to detect the tension in the one or more cables 32. The marine transfer system 1 may further comprise a control means configured to control the tension in the one or more cables 32 and the vertical movement of the gangway assembly 18 with respect to the marine vessel 2.

[0060] The one or more cables 32 may be coupled to the plurality of coupling elements 24. The coupling elements 24 may comprise pulleys or guides configured to redirect the cables 32. The cable 32 may be wound around at least one of the coupling elements 24 one or more times. The one or more cables 32 may comprise a first point of the cables 32 that is connected to the winch assembly 26 and a second point of the cables 32 that is connected to the winch assembly 26 or an anchor point.

[0061] In the example shown in figures 1, 4 and 5, the winch assembly 26 comprises a first spool 28 and a second spool 30 provided on a common shaft. The cable 32 is coupled to the plurality of coupling elements 24, the coupling elements 24 being moveable and provided at the first and second ends of the support members 22. The first point of the cable 32 is coupled to the first spool 28 and the second point of the cable 32 is coupled to the second spool 28. The cable is wound in the same direction on the first and second spools 28, 30 such that rotation of the winch assembly 26 in one direction causes the cable 32 to un-wind from the first and second spools 28, 30 and rotation of the winch assembly 26 in the other direction causes the cable 32 to wind onto the first and second spools 28, 30, thereby adjusting the length of the unwound cable 32 that couples the plurality of coupling elements 24 of the support assembly 20. The winch assembly 26 is, therefore, operable to adjust the length of the unwound cable for the purpose of maintaining a tension force in the cable 32 in order to provide structural rigidity to the support assembly 20 and permit the vertical movement of the gangway assembly 18 with respect to the marine vehicle 2. In the example shown in figures 1, 4 and 5, the cable 32 is coupled to the plurality of coupling elements 24. However, in an alternative embodiment (not shown) the coupling elements 24 may comprise one or more pulley wheels wherein the cable 32 may be wound one or more times around at least one of the pulley wheels

for the purposes of reducing the stress in the cable 32 at a point where the cable 32 is coupled to the coupling element 24, providing a mechanical advantage and/or reducing the overall spooling requirements of the first and second spools 28, 30 of the winch assembly 26.

[0062] The winch assembly 26 may be operated manually from a remote location, for example from the cabin 5 of the marine vessel 2 or from the platform assembly 6 and/or gangway assembly 18. The winch assembly 26 may also be controlled automatically, for example by a control system.

[0063] Figure 4 shows the marine transfer system 1 of the marine vessel 2 secured to the structure 4 when the marine vessel 2 is at the crest of a wave with the support assembly 20 in a first position contracted towards the deck 3 of the marine vessel 2. Figure 5 shows the marine transfer system 1 of the marine vessel 2 secured to the structure 4 when the marine vessel 2 is at the trough of a wave with the support assembly 20 in a second position extended away from the deck 3 of the marine vessel 2. As the marine vessel 2 heaves with the motion of the sea, the support assembly 20 repeatedly contracts towards and extends away from the deck 3 of the marine vessel 2. The structural rigidity of the support assembly 20 may result from the tension in the cable 32. Therefore, as the support assembly contracts towards the deck 3 of the marine vessel 2, the sensor of the winch assembly 26 detects a reduction in the tension of the cable 32 and the control system operates the winch assembly 26 such that cable 32 is wound onto the first and second spools 28, 30 in order to maintain the tension in the cable 32, thereby preserving the structural integrity of the support assembly 20 as the marine vessel 2 rises to the crest of the wave.

[0064] Conversely, as the support assembly 20 extends away from the deck 3 of the marine vessel 2, the sensor of the winch assembly 26 detects an increase in the tension of the cable 32 and the control system operates the winch assembly 26 such that cable 32 is unwound from the first and second spools 28, 30 in order to maintain the tension in the cable 32, thereby preserving the structural integrity of the support assembly 20 as the marine vessel falls to the trough of the wave.

[0065] In another example (not shown), the winch assembly 26 may comprise a single spool. The cable 32 may be wound round the spool such that first point of cable 32 is coupled to the spool. The second point of the cable 32 may be coupled to the anchor point. The length of un-wound cable 32 may be connected to one or more coupling elements 24 of the support assembly 20.

[0066] In another example (not shown), the winch assembly 26 may comprise a plurality of winches and/or a plurality of anchor points that may be configured to support the gangway assembly 18.

[0067] In the example shown in figures 1, 4 and 5, the first and second spools 28, 30 have the same diameter. Thus the rate at which cable 32 is wound/un-wound is the same for the first and second spools 28, 30. However,

in another example, the diameter of the first spool 28 may be different from the diameter of the second spool 30, in which case, the rate at which cable 32 is wound/unwound is different for each spool. Thus, by providing spools of different diameter, a gearing may be set up that allows for cable 32 to be wound/unwound at different rates between the spools 28, 30. Furthermore, such a set-up allows for the cable 32 to be wound round the spools 28, 30 in opposing directions.

[0068] The support assembly 20 for the marine transfer system 1 as disclosed in the present invention is supported by virtue of the tensioned cables 32 and the winch assembly 26. The height of the gangway assembly 18 above the deck 3 of the marine vessel may be controlled therefore by adjusting the tension in the cables 32 using the appropriate sensors and control system (not shown) to operate the winch assembly 26. This allows for the rapid adjustment of the tension in the cables 32 to provide constant support for the motion-compensated gangway assembly 18 in response to the heave of the marine vessel 2. Owing to its simplicity, the reliability and service issues of hydraulic/robotic support systems may be avoided. The marine transfer system 1 operates on low power requirements and the simple means of self-adjustment requires minimum input from an operator whilst transfers take place. When not in use, the gangway assembly 18 may be folded into a collapsed position such that the gangway assembly 18 may be stowed in a position that does not obscure the visibility from the cabin 5 of the marine vessel 2. Consequent to the simplicity of the present invention, the marine transfer system 1 is light-weight, which results in less weight borne at the bow of the marine vessel, which improves the performance of the marine vessel 2. Furthermore, the overall reduction in weight of the marine vessel 2 results in an improved efficiency and reduced emissions.

[0069] In addition, the invention as presently disclosed provides an improved operation and maintenance capability in higher sea states, which increases the efficiency of the transfer of personnel and/or materials between the marine vessel 2 and the structure 4. Due to the configuration of the support assembly 20, such transfers will be able to take place in conditions of up to 2 m significant wave height (Beaufort Scale 4 - 5) and the marine transfer system 2 may be used in the deeper water wind farms (Phase 3) where transfer times between offshore wind turbines becomes a greater consideration.

[0070] Figure 6 shows a further embodiment of the marine transfer system 1, in which the marine transfer system 1 of the marine vessel 2 is secured to the structure 4 when the marine vessel 2 is at the crest of a wave. In the example of figure 6, the support assembly 20 is in a first position contracted towards the deck 3 of the marine vessel 2. The further embodiment of the support assembly 20, as shown in figure 6, may comprise similar features to those described above, the features and benefits of which apply equally to the further embodiment described below. In the further embodiment of the support

assembly 20, the support assembly 20 may comprise a single movable elongate support member 22 that may have a first end 22' pivotably and/or slidably coupled to the gangway assembly 18 and a second end 22" pivotably and/or slidably coupled to the deck 3 of the marine vessel 2. The coupling elements 24 may be provided at the first end 22' of the single support member 22, although it may be appreciated that the coupling elements 24 may be provided at any point on the support assembly 20. For the embodiment shown in figure 6 and any other embodiment, coupling elements 24 may be provided at other points of the marine vessel 2, for example, on the platform assembly 6 and/or on the deck 3. The support assembly 20 may comprise the winch assembly 26 and one or more cables 32. The one or more cables 32 may be coupled to the coupling elements 24 on the single support member 22 and optionally the deck 3 of the marine vessel 2 and wound round the winch assembly 26. The coupling element 24 provided on the deck 3 may comprise the anchor point for the cable 32. The first point of the cables 32 may be connected to the winch assembly 26 and the second point of the cables 32 may be connected to the winch assembly 26 or the anchor point. In the embodiment shown in figure 6 the first and second points of the cable 32 are coupled to the winch assembly 26, the cable extending around the coupling elements 24 provided at the first end 22' of the single support member 22 and on the deck 3 of the marine vessel. It is appreciated however that the cable 32 may not be coupled to the coupling element 24 on the deck 3. The winch assembly 26 may be operable therefore to adjust the length of the unwound cable 32 for the purpose of maintaining a tension force in the cable 32 in order to provide structural rigidity to the support assembly 20 and permit the vertical movement of the gangway assembly 18 with respect to the marine vehicle 2.

[0071] Figures 7 and 8 show another embodiment of the marine transfer system 1, in which the bumper member 8 is pivotably connected to the platform assembly 6, for example by virtue of a hinged coupling. The platform assembly 6 is coupled to the gangway assembly 18, for example by way of a universal coupling, which allows the platform assembly 6 and the bumper member 8 to articulate freely with respect to the gangway assembly 18 and the support assembly 20. In figure 7, the marine transfer system 1 is secured to the structure 4 when the marine vessel 2 is at the crest of a wave with the support assembly 20 in a first position contracted towards the deck 3 of the marine vessel 2. In figure 8, the marine transfer system 1 is secured to the structure 4 when the marine vessel 2 is at the trough of a wave with the support assembly 20 in a second position extended away from the deck 3 of the marine vessel 2.

[0072] The other embodiment of the support assembly 20, as shown in figures 7 and 8, may comprise similar features to those of the embodiments described above, the features and benefits of which apply equally to the other embodiment described below. In the other embod-

iment, the support assembly 20 comprises first and second movable, elongate support members 22a, 22b. Although not evident from figures 7 and 8, the first support member 22a may comprise an A-frame type structure having a first end 22a' pivotably and slidably coupled to the gangway assembly 18 and having two second ends 22a" pivotably coupled to the deck 3 of the marine vessel 2. The second support member 22b has a first end 22b' coupled, for example rigidly coupled, to a portion of the force transfer mechanism 14 of the gripping assembly 10. Another portion of the force transfer mechanism 14 is coupled, for example pivotably coupled, to the bumper member 8 such that the force transfer mechanism couples the first end 22b' of the second support member 22b to the bumper member 8. The second support member 22b has a second end 22b" pivotably coupled to the deck 3 of the marine vessel 2. It is appreciated, however, that the first and second support members 22a, 22b may be of any appropriate form that permit the support assembly 20 to support the gangway assembly 18, the platform assembly 6, the gripping assembly 10 and/or the bumper member 8.

[0073] One difference between the previously mentioned embodiments and the embodiment of figures 7 and 8 is that the second support member 22b is extendable. In the example of figures 7 and 8, the second support member 22b is a telescopic support member comprising two concentrically arranged support member portions 22b1, 22b2 configured to slide relative to each other. It is appreciated, however, that the support assembly 20 may comprise any number of support members 22 each having any number of support member portions movably coupled, for example slidably and/or pivotably coupled, to one another. In one example, the support member portions 22b1, 22b2 may be movably coupled by virtue of a guide rail and follower member arrangement, and/or any other appropriate linkage.

[0074] In the example of figures 7 and 8, the second support member 22b is lockable such that the relative movement between the support member portions 22b1, 22b2 may be selectively permitted. In one example, the second support member 22b may comprise a locking mechanism, e.g. a locking pin, configured to lock the positions of the support member portions 22b1, 22b2 relative to each other, although it is appreciated that the relative movement between the support member portions 22b1, 22b2 may be locked by any appropriate means, for example by the locking of a hydraulic circuit.

[0075] In the example shown in figure 7 and 8, the locking mechanism is disengaged such that the relative movement between the support member portions 22b1, 22b2 is permitted. Whilst not shown in any of the accompanying figures, it will be appreciated that, upon engagement of the marine transfer system 1 to the structure 4, the locking mechanism may be engaged so as to prevent the relative movement between the support member portions 22b1, 22b2.

[0076] In a similar manner to that described for the

above-embodiments, following the engagement of the bumper member 8 with the structure 4, movement of the marine vessel 2 towards the structure 4 causes the bumper member 8 to move from the first position to the second position. As the bumper member 8 moves from the first position to the second position, the bumper member 8 moves relative to the marine vessel 2, and may move, for example pivot, relative to the platform assembly 6. The force transfer mechanism 14 converts the movement of the bumper member 8 to movement of the gripping elements 12, causing the gripping elements 12 to move, e.g. pivot, from an open position to a closed position. In the example of figures 7 and 8, the force transfer mechanism 14 comprises the hydraulic piston 14a that is actuated by the movement of the bumper member 8 from the first position to the second position. It is appreciated, therefore, that as the bumper member 8 moves relative to the marine vessel 2, the hydraulic piston 14a is actuated from an extended position (not shown) to a compressed position as shown in figures 7 and 8. It is further appreciated that compression of the hydraulic piston 14a may only be possible when the relative movement between the support member portions 22b1, 22b2 is not permitted, for example when the locking mechanism is engaged. In one example, the marine transfer system 1 may comprise a controller configured to control the engagement of the locking mechanism. The controller may be configured to determine the loading on the marine transfer system 1, for example by way of a sensor, as a result of the engagement of the marine transfer system 1 to the structure 4. In one example, the controller may be configured to disengage the locking mechanism upon actuation of the gripping elements 12 from an open position to a closed position.

[0077] In the example shown in figures 7 and 8, the coupling elements 24 are provided at the first end 22a' of the support member 22a and at a point on the bumper member 8. It is appreciated though that the coupling elements 24 may be provided at any point on the marine transfer system 1, for example any point on the support assembly 20, the platform assembly 6, the gangway assembly 18 and/or the gripping assembly 10, and/or at any point on the marine vessel 2.

[0078] In the example of figures 7 and 8, the support assembly 20 comprises the winch assembly 26 and one or more cables 32. The winch assembly 26 is provided on the deck 3 of the marine vessel 2 at a point between the second ends 22a" of the first support member 22a, but may however be provided at any appropriate point on the deck 3. The cable 32 is coupled to the coupling element 24 at the first end 22a' of the support member 22a and the coupling element 24 on the bumper member 8, and is wound round the winch assembly 26. The winch assembly 26 is operable therefore to adjust the length of the unwound cable 32 for the purpose of maintaining a tension force in the cable 32 in order to provide structural rigidity to the support assembly 20 and permit the vertical movement of the gangway assembly 18, the platform as-

sembly 6, the bumper member 8 and the gripping assembly 10 with respect to the marine vehicle 2. It is appreciated that the winch assembly 26 may be operable to adjust the length of the unwound cable 32 for the purpose of maintaining a tension force in the cable 32 as the hydraulic piston 14a is actuated between the extended position (not shown) and the compressed position as shown in figures 7 and 8.

[0079] In figure 7, the marine vessel 2 is at the peak of a wave with the marine transfer system 1 contracted towards the deck 3 and the second support member 22b in a shorter state. As the marine vessel 2 falls to the trough of the wave, as shown in figure 8, the marine transfer system 1 extends away from the deck 3 and the second support member 22b extends in length. The extendable support member may be free to extend and contract. However, in one example, the extendable support member may be lockable such that the extendable support member is unable to increase or decrease in length as the marine vessel 2 rises and falls with the wave. In another example, the extendable support member may be operated by a control system configured to actively adjust the length of the extendable support member, for example by way of a hydraulic system, depending upon the operational requirements of the marine transfer system 1.

[0080] As mentioned above, the gripping assembly 10 further comprises one or more gripping elements 12. The gripping elements 12 are configured such that when an upward force is applied to the platform assembly 6, the one or more gripping elements 12 move into a first position relative to the structure 4 in which the gripping assembly 10 is able to slide upwards with respect to the structure 4 (for example, as shown in figure 9). The gripping assembly 10 is further configured such that when the upward force is not applied to the platform assembly 6, the one or more gripping elements 12 move into a second position relative to the structure 4 in which the gripping assembly 10 grips the structure 4 and prevents downwards movement of the gripping assembly 10 with respect to the structure 4 (for example, as shown in figure 10). The gripping assembly 10 may comprise two or more gripping elements 12 spaced apart from each other. The gripping assembly 10 may comprise a pair of gripping elements 12 configured to engage a first portion and a second portion of the structure 4. The gripping elements 12 may be configured to not interfere with any feature of the structure 4, e.g. a supporting element 4a of the structure 4, in a way that may cause damage to and/or impair the function of the structure 4 and/or gripping elements 12 as the gripping assembly 10 slides up the structure 4.

[0081] The gripping assembly 10 may further comprise a second biasing mechanism configured such that the gripping elements 12 are biased towards the second position, i.e. as the upwards force is applied to the platform assembly, the upwards force acts against a biasing force. The biasing force may be selectable such that the upwards force required to cause the gripping elements 12 to move from the second position to the first position may

be set at a desired level. The second biasing mechanism may comprise one or more second spring elements, or any other appropriate mechanism, that cause the gripping elements 12 to be biased towards the second position. The gripping elements may additionally or alternatively be biased into their open position by a further biasing mechanism.

[0082] In the example shown in figures 1, 9 and 10, the gripping assembly comprises two pairs of gripping elements 12 that are vertically spaced apart from each other. The gripping assembly 10 comprises first and second gripping elements 12a, 12b configured such that when the gripping assembly 10 is coupled to the structure 4 the coupling between the first gripping element 12a and the structure 4 has a first degree of play and the coupling between the second gripping element 12b and the structure 4 has a second degree of play that is greater than the first degree of play, i.e. the coupling between the second gripping element 12b and the structure 4 is looser than the coupling between the first gripping element 12a and the structure 4.

[0083] The variation in the degree of play between the first gripping element 12a and the second gripping element 12b may be achieved by: off-setting the pivot axis of the second gripping element 12b with respect to the pivot axis of the first gripping element 12a; making the second gripping element 12b longer than the first gripping element 12a; tapering the thickness of the bumper member 8 from a thicker cross-section towards the bottom of the bumper member 8 to a thinner cross-section towards the top of the bumper member 8; and/or any other alternative means by which the coupling between the second gripping element 12b and the structure 4 is looser than the coupling between the first gripping element 12a and the structure 4.

[0084] Figures 3a to 10 show the gripping assembly 10 coupled to the structure 4. It is appreciated that when the gripping assembly 10 is coupled to the structure 4, the marine vessel 2 will be heaving with the motion of the waves. Consequently, as the marine vessel 2 falls to the trough of a wave, the weight of the marine vessel 2 borne by the coupling between the gripping assembly 10 and the structure 4 increases. By virtue of this increased loading on the coupling, a gripping force of the first and second gripping elements 12a, 12b is sufficient to resist the downward movement of the gripping assembly 10 with respect to the structure 4.

[0085] Conversely, as the marine vessel 2 rises to the crest of the wave, an upward force **F** is applied to the marine vessel 2 by the wave. The upward force **F** may be transmitted through the deck of the marine vessel 3 to the marine transfer system 1 such that the upward force **F** acts on the marine transfer system 1 when the gripping assembly 10 is coupled to the structure 4. Figure 9 shows the gripping elements 12a, 12b in the first position, i.e. when the marine vessel is rising to the crest of the wave, with the upward force **F** applied to the marine transfer system 1, and consequently the platform assem-

bly 6. When the upward force **F** is applied to the platform assembly 6, the increased degree of play in the second gripping element 12b allows the platform assembly 6 and the gripping assembly 10 to pivot about the first gripping element 12a. As the platform assembly 6 and the gripping assembly 10 pivot, the gripping force of the second gripping element 12b reduces such that the combined gripping force between the first and second gripping elements 12a, 12b is insufficient to resist the upwards force **F** applied to the platform assembly 6. Consequently, the gripping assembly 10 slides upwards with respect to the structure 4.

[0086] Figure 10 shows the gripping elements 12a, 12b in the second position, i.e. when the marine vessel is falling to the trough of the wave, with the upward force **F** not applied to the platform assembly 6. The gripping force of the second gripping element 12b is greater in the second position. The combined gripping force of the first and second gripping elements 12a, 12b is sufficient to support the weight of the marine transfer system 1 and resist the downward movement of the gripping assembly 10 with respect to the structure 4.

[0087] In another embodiment (not shown) the gripping elements 12 may comprise one or more wedge elements configured to engage the structure 4. The gripping elements 12 may be configured such that when the upward force **F** is applied to the platform assembly 6, the wedge elements are forced into a locking position, thereby acting to grip the structure 4. Conversely, when the upward force **F** is not applied to the platform assembly 6, the wedge elements may move out of the locking position, thereby acting to release the grip on the structure 4. The gripping elements may comprise one or more resilient elements that are configured to grip the structure 4 upon compression by one or more of the wedge elements.

[0088] In another embodiment (not shown) the gripping assembly 10 may further comprise a gripping mechanism configured to actuate the gripping elements 12 consequent to the marine vessel 2 rising and falling with the motion of the waves. The gripping mechanism may comprise one or more pneumatic, hydraulic and/or electro-mechanical devices configured to actuate the gripping elements 12. The gripping mechanism may at least partially comprise the force transfer mechanism 14 that operatively connects the bumper member 8 to the gripping elements 12. The gripping mechanism may further comprise one or more sensing devices, e.g. an accelerometer or a force transducer, configured to detect the motion of the marine vessel 2. The sensing device may be configured to determine the required gripping force of the gripping elements 12 and provide a signal to the gripping mechanism. In this manner, the gripping mechanism may be operable to adjust the gripping force of the gripping elements. For example, the gripping mechanism may be configured such that when the marine vessel is rising to the crest of the wave, with the upward force **F** applied to the marine transfer system 1, the gripping

mechanism actuates the gripping elements 12 into the first position in which the gripping force of the gripping elements 12 is insufficient to resist the upwards force **F** applied to the marine transfer system 1. Consequently, the gripping assembly 10 slides upwards with respect to the structure 4. Conversely, the gripping mechanism may be configured such that when the marine vessel is falling to the trough of the wave, with the upward force **F** not applied to the marine transfer system 1, the gripping mechanism actuates the gripping elements 12 into the second position in which the gripping force of the gripping elements 12 is sufficient to support the weight of the marine transfer system 1 and resist the downward movement of the gripping assembly 10 with respect to the structure 4.

[0089] The present application claims priority from UK patent application GB1313227.9. The claims of GB1313227.9, along with some additional statements, are presented as numbered statements below in order to preserve this subject matter in the present application.

Statements

[0090]

1. A marine transfer system for securing a marine vessel to a structure, the marine transfer system comprising: a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure; a bumper member movably coupled to the platform assembly, wherein the bumper member is configured to contact the structure and is movable relative to the platform assembly between a first position and a second position; and a gripping assembly, the gripping assembly comprising: one or more gripping elements coupled to the bumper member, wherein the gripping elements are configured to selectively engage the structure to secure the marine transfer system to the structure; and a force transfer mechanism that operatively connects the bumper member to the gripping elements, the force transfer mechanism being configured to actuate the gripping elements from an open position to a closed position in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

2. A marine transfer system according to statement 1, the marine transfer system further comprising: a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure; and a support assembly configured to support the gangway assembly and permit vertical movement with respect to the marine vessel, the support assembly comprising: a winch assembly; and one or more cables coupled to the support assembly and/or the gangway assembly, the cables being wound round the winch assembly so that the

winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of the gangway assembly with respect to the marine vessel.

3. A marine transfer system according to statement 1 or 2, wherein the gripping assembly is configured to couple the platform assembly to the structure, wherein the gripping assembly is configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure; and wherein the gripping assembly is further configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure.

4. A marine transfer system for transferring personnel and/or materials between a marine vessel and a structure, the marine transfer system comprising: a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure; and a support assembly configured to support the gangway assembly and permit vertical movement of the gangway assembly with respect to the marine vessel, the support assembly comprising: a winch assembly; and one or more cables coupled to the support assembly and/or the gangway assembly, the cables being wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of the gangway assembly with respect to the marine vessel.

5. A marine transfer system according to statement 4, the marine transfer system further comprising: a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure; and a gripping assembly configured to couple the platform assembly to the structure, the gripping assembly comprising one or more gripping elements, wherein the gripping assembly is configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure; and wherein the gripping assembly is further configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and

prevents downwards movement of the gripping assembly with respect to the structure.

6. A marine transfer system according to statement 4 or 5, the marine transfer system further comprising: a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure; a bumper member movably coupled to the platform assembly, wherein the bumper member is configured to contact the structure and is movable relative to the platform assembly between a first position and a second position; and a gripping assembly, the gripping assembly further comprising: one or more gripping elements coupled to the bumper member, wherein the gripping elements are configured to selectively engage the structure to secure the marine transfer system to the structure; and a force transfer mechanism that operatively connects the bumper member to the gripping elements, the force transfer mechanism being configured to actuate the gripping elements from an open position to a closed position in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

7. A marine transfer system for coupling a marine vessel to a structure, the marine transfer system comprising: a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure; and a gripping assembly configured to couple the platform assembly to the structure, the gripping assembly comprising one or more gripping elements, wherein the gripping assembly is configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure; and wherein the gripping assembly is further configured such that when the upward force is not applied to the platform assembly, the one or more gripping elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure.

8. A marine transfer system according to statement 7, the marine transfer system further comprising: a bumper member movably coupled to the platform assembly, wherein the bumper member is configured to contact the structure and is movable relative to the platform assembly between a first position and a second position; wherein one or more of the gripping are elements coupled to the bumper member are configured to selectively engage the structure to secure the marine transfer system to the structure; the gripping assembly further comprising: a force

transfer mechanism that operatively connects the bumper member to the gripping elements, the force transfer mechanism being configured to actuate the gripping elements from an open position to a closed position in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

9. A marine transfer system according to statement 7 or 8, the marine transfer system further comprising: a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure; and a support assembly configured to support the gangway assembly and permit vertical movement with respect to the marine vessel, the support assembly comprising: a winch assembly; and one or more cables coupled to the support assembly and/or the gangway assembly, the cables being wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of the gangway assembly with respect to the marine vessel.

10. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6 or 8, wherein the force transfer mechanism is a hydraulic or pneumatic system.

11. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6, 8 or 10, wherein the bumper member is slidably coupled to the platform assembly.

12. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6, 8, 10 or 11, wherein the bumper member comprises a resilient member configured to deform upon contact with the structure.

13. A marine transfer system according to any of the preceding statements when dependent on statements 2, 5, 6, or 9, wherein the platform assembly is further configured to engage the gangway assembly.

14. A marine transfer system according to any of the preceding statements when dependent on statements 2, 5, 6, or 9, wherein the gangway assembly is further configured to engage the platform assembly and/or a deck of the marine vessel.

15. A marine transfer system according to any of the preceding statements when dependent on statements 2, 5, 6, or 9, wherein the gangway assembly is slidably or pivotably coupled to the platform assembly and/or the deck of the marine vessel.

16. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the support assembly comprises a plurality of winch assemblies.

17. A marine transfer system according to any of the preceding statements, wherein the structure is part of a wind turbine, an offshore platform, a harbour wall or part of another marine vessel.

18. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the or each winch assembly comprises a first spool and a second spool provided on a common shaft, the first and second spools being adapted to receive first and second points of the cable respectively.

19. A marine transfer system according to statement 18, wherein the cable is wound in a first direction on the first spool and in a second direction on the second spool and the first direction is the same as the second direction.

20. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the winch assembly comprises a sensor configured to detect the tension in the cable.

21. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the marine transfer system further comprises a control means, the control means being configured to control the tension in the one or more cables and the vertical movement of at least a portion of the marine transfer system with respect to the marine vessel.

22. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the gangway assembly comprises one or more gangways.

23. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6 or 8, wherein the first and/or second gripping elements comprise jaw members and/or hook members.

24. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6 or 8, wherein the gripping assembly comprises two or more gripping elements spaced apart from one another.

25. A marine transfer system according to any of the preceding statements when dependent on state-

ments 1, 6 or 8, wherein the gripping assembly comprises a pair of gripping elements configured to engage a first portion and a second portion of the structure.

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26. A marine transfer system according to statement 24 or 25, wherein the gripping elements are spaced apart vertically.

27. A marine transfer system according to any of the statements 24 to 26, wherein the gripping elements are spaced apart laterally.

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28. A marine transfer system according to any of the preceding statements when dependent on statements 3, 5 or 7, wherein the gripping assembly comprises first and second gripping elements configured such that when the gripping assembly is coupled to the structure the coupling between the first gripping element and the structure has a first degree of play and the coupling between the second gripping element and the structure has a second degree of play that is greater than the first degree of play.

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29. A marine transfer system according to statement 28, wherein the second gripping element is disposed above the first gripping element.

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30. A marine transfer system according to any of the preceding statements when dependent on statements 3, 5 or 7, wherein the gripping elements are pivotably coupled to the gripping assembly.

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31. A marine transfer system according to any of the preceding statements when dependent on statements 2, 6 or 9, wherein the support assembly is configured to support the bumper member, the platform assembly and/or the gripping assembly.

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32. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the support assembly comprises one or more support members configured to support the gangway assembly on the marine vessel.

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33. A marine transfer system according to statement 32, wherein the support assembly comprises first and second support members each comprising first and second ends.

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34. A marine transfer system according to statement 33, wherein the first ends of the first and second support members are pivotably and/or slidably coupled to the gangway assembly and the second ends of the first and second support members are pivotably and/or slidably coupled to the deck of the marine vessel.

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35. A marine transfer system according to statement 33 or 34, wherein the first and second support members are pivotably and/or slidably coupled together at a point between their respective first and second ends.

35. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the support assembly comprises one or more coupling elements provided on points of the support assembly.

36. A marine transfer system according to statement 35, wherein the points at which the coupling elements are provided on the support assembly are movable with respect to the marine vessel.

37. A marine transfer system according to statement 35 or 36, wherein the one or more cables are coupled to the one or more coupling elements.

36. A marine transfer system according to any of statements 32 to 35, wherein one or more of the support members are extendable.

37. A marine transfer system according to any of statements 32 to 36, wherein one or more of the support members each comprise two or more movably coupled support member portions.

38. A marine transfer system according to statement 37, wherein the position of the support members portions of each support member is selectively lockable relative to one another.

39. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, the marine transfer system further comprising one or more coupling elements provided on points of the marine transfer system, the one or more cables being coupled to the one or more coupling elements.

40. A marine transfer system according to statement 39, wherein the points at which the coupling elements are provided on the marine transfer system are movable with respect to the marine vessel.

41. A marine transfer system according to statement 39 or 40 when dependent on statements 1, 6 or 8, wherein the coupling elements are provided on points of the platform assembly, the bumper member and/or the gripping assembly.

42. A marine transfer system according to statement 39 or 40 when dependent on statements 2, 4 or 9, wherein the coupling elements are provided on points of the gangway assembly and/or the support

assembly.

43. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the one or more cables are configured such that a first point of the cables connected to the winch assembly and a second point of the cables connected to the winch assembly, a further winch assembly or an anchor point.

44. A marine transfer system according to any of the preceding statements when dependent on statements 2, 4 or 9, wherein the tension force in the one or more cables provides structural rigidity to the support assembly.

45. A marine transfer system according to any of the preceding statements when dependent on statements 3, 5 or 7, wherein the gripping assembly further comprises a gripping mechanism configured to adjust a gripping force of the gripping elements.

46. A marine transfer system according to statement 45, wherein the gripping assembly further comprises one or more sensing devices configured to determine the motion of the boat and provide a signal to the gripping mechanism.

47. A marine transfer system according to any of the preceding statements when dependent on statements 1, 6 or 8, wherein the bumper member comprises a first biasing mechanism configured to bias the bumper member towards the first position of the bumper member.

48. A marine transfer system according to any of the preceding statements when dependent on statements 3, 5 or 7, wherein the gripping assembly further comprises a second biasing mechanism configured to bias the gripping elements towards the second position of the gripping elements.

49. A marine vessel comprising the marine transfer system as stated in statements 1, 4 or 7.

50. A method of transferring personnel and/or materials between a marine vessel and a structure, the method comprising: engaging a marine transfer system with the structure; gripping the structure with a gripping assembly of the marine transfer system to secure the marine transfer system to the structure; permitting upward movement of the gripping assembly with respect to the structure; preventing downward movement of the gripping assembly with respect to the structure; and supporting a gangway assembly of the marine transfer system, the gangway assembly at one end being operatively connected to the gripping assembly and being configured to

carry personnel and/or materials between the marine vessel and the structure.

51. A method of transferring personnel and/or materials between the marine vessel and the structure according to statement 50, wherein the method further comprises: de-gripping the gripping assembly of the marine transfer system from the structure; disengaging the marine transfer system from the structure; and lowering the gangway assembly towards the deck of the marine vessel.

52. A marine transfer system as described herein, with reference to, and as shown in the accompanying drawings.

53. A method of transferring personnel and/or materials between the marine vessel and the structure as described herein, with reference to, and as shown in the accompanying drawings.

[0091] It will be appreciated by those skilled in the art that although the invention has been described by way of example with reference to one or more examples, it is not limited to the disclosed examples and that alternative examples could be constructed without departing from the scope of the invention as defined by the appended claims.

Reference numerals

[0092]

1	marine transfer system
2	marine vessel
3	deck of the marine vessel
4	structure
4	supporting element of the structure
5	cabin of the marine vessel
6	platform assembly
7	protruding portions
8	bumper member
9	receiving portions
10	gripping assembly
12	gripping elements
14	force transfer mechanism
14a	hydraulic piston
16	resilient member
17	first gangway
18	gangway assembly
19	second gangway
20	support assembly
22	support member
22'	first end of support member
22"	second end of support member
22a	first support member
22a'	first end of first support member
22a"	second end of first support member

22b second support member
 22b' first end of second support member
 22b" second end of second support member
 22b1 support member portion
 22b2 support member portion
 23 bearing
 24 coupling element
 25a slot in first support member
 25b slot in second support member
 26 winch assembly
 28 first spool
 30 second spool
 32 cable

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a winch assembly; and
 one or more cables coupled to the support assembly and/or the gangway assembly, the cables being wound round the winch assembly so that the winch assembly is operable to adjust the length of unwound cable to maintain a tension force in the cable and permit the vertical movement of the gangway assembly with respect to the marine vessel.

3. A marine transfer system according to claim 2, wherein the support assembly comprises at least a portion of the force transfer mechanism.

4. A marine transfer system according to claim 2 or 3, wherein the support assembly is configured to support the bumper member, the platform assembly and/or the gripping assembly.

5. A marine transfer system according to any of claims 2 to 4, wherein the tension force in the one or more cables provides structural rigidity to the support assembly.

6. A marine transfer system according to any of claims 2 to 5, wherein the marine transfer system further comprises a control means, the control means being configured to control the tension in the one or more cables and the vertical movement of at least a portion of the marine transfer system with respect to the marine vessel.

7. A marine transfer system according to any of claims 2 to 6, the marine transfer system further comprising one or more coupling elements provided on points of the marine transfer system, the one or more cables being coupled to the one or more coupling elements.

8. A marine transfer system according to claim 7, wherein the coupling elements are provided on points of the support assembly, the platform assembly, the bumper member and/or the gripping assembly.

9. A marine transfer system according to any of the preceding claims, wherein the gripping assembly is configured to couple the platform assembly to the structure, wherein

the gripping assembly is configured such that when an upward force is applied to the platform assembly, the one or more gripping elements move into a first position relative to the structure in which the gripping assembly is able to slide upwards with respect to the structure; and

wherein the gripping assembly is further configured such that when the upward force is not applied to the platform assembly, the one or more gripping el-

Claims

1. A marine transfer system for securing a marine vessel to a structure, the marine transfer system comprising:

a platform assembly configured to carry personnel and/or materials between the marine vessel and the structure;

a bumper member movably coupled to the platform assembly, wherein the bumper member is configured to contact the structure and is movable relative to the platform assembly between a first position and a second position; and
 a gripping assembly, the gripping assembly comprising:

one or more gripping elements coupled to the bumper member, wherein the gripping elements are configured to selectively engage the structure to secure the marine transfer system to the structure; and
 a force transfer mechanism that operatively connects the bumper member to the gripping elements, the force transfer mechanism being configured to actuate the gripping elements from an open position to a closed position in which the marine transfer system is secured to the structure upon movement of the bumper member from the first position to the second position.

2. A marine transfer system according to claim 1, the marine transfer system further comprising:

a gangway assembly configured to carry personnel and/or materials between the marine vessel and the structure; and
 a support assembly configured to support the gangway assembly and permit vertical movement with respect to the marine vessel, the support assembly comprising:

elements move into a second position relative to the structure in which the gripping assembly grips the structure and prevents downwards movement of the gripping assembly with respect to the structure.

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10. A marine transfer system according to any of the preceding claims, wherein the gripping assembly comprises two or more gripping elements spaced apart from one another.

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11. A marine transfer system according to any of the preceding claims, wherein the gripping assembly further comprises a gripping mechanism configured to adjust a gripping force of the gripping elements.

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12. A marine transfer system according to any of the preceding claims, wherein the gripping assembly further comprises one or more sensing devices configured to determine the motion of the boat and provide a signal to the gripping mechanism.

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13. A marine transfer system according to any of the preceding claims, wherein the bumper member comprises a first biasing mechanism configured to bias the bumper member towards the first position of the bumper member.

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14. A method of transferring personnel and/or materials between a marine vessel and a structure, the method comprising:

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engaging a marine transfer system with the structure;

gripping the structure with a gripping assembly of the marine transfer system to secure the marine transfer system to the structure;

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permitting upward movement of the gripping assembly with respect to the structure;

preventing downward movement of the gripping assembly with respect to the structure; and

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supporting a gangway assembly of the marine transfer system, the gangway assembly at one end being operatively connected to the gripping assembly and being configured to carry personnel and/or materials between the marine vessel and the structure.

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15. A method of transferring personnel and/or materials between the marine vessel and the structure according to claim 14, wherein the method further comprises:

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de-gripping the gripping assembly of the marine transfer system from the structure;

disengaging the marine transfer system from the structure; and

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lowering the gangway assembly towards the deck of the marine vessel.

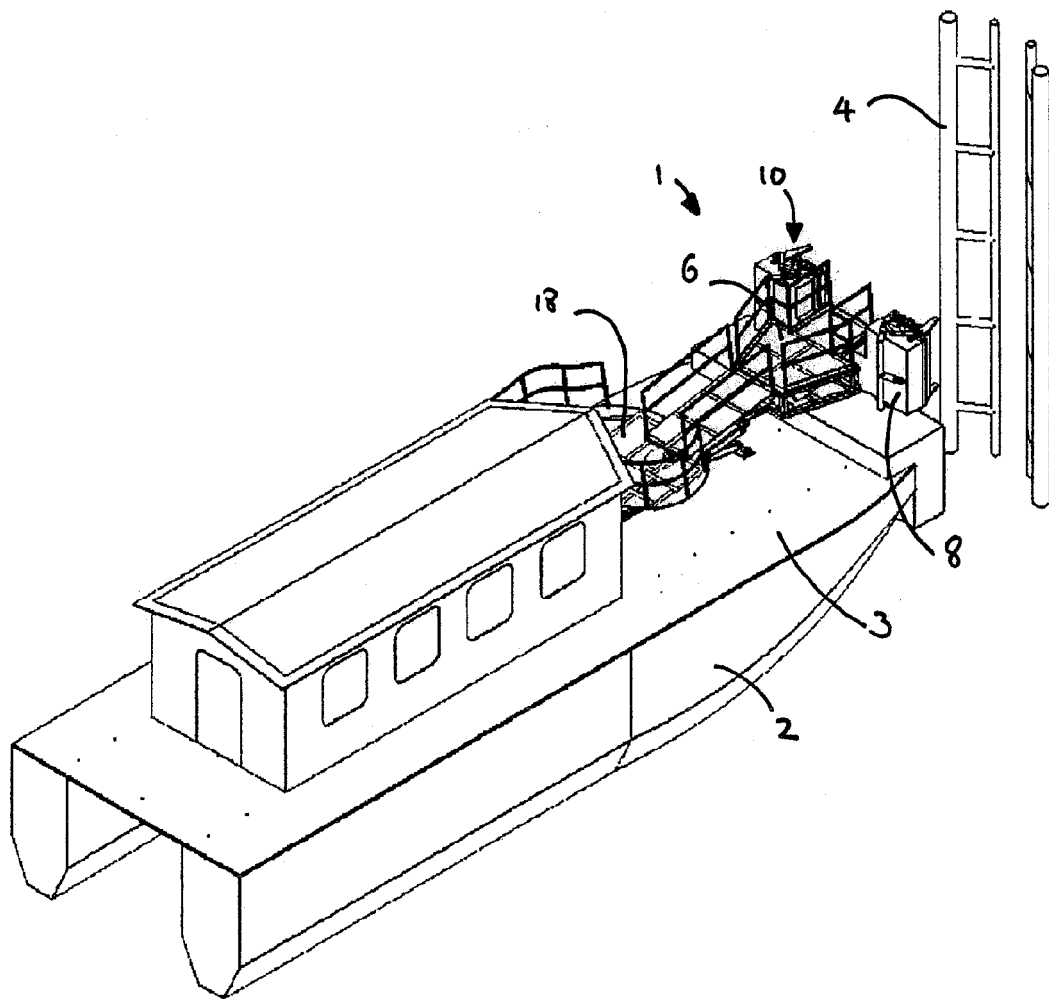


Figure 1

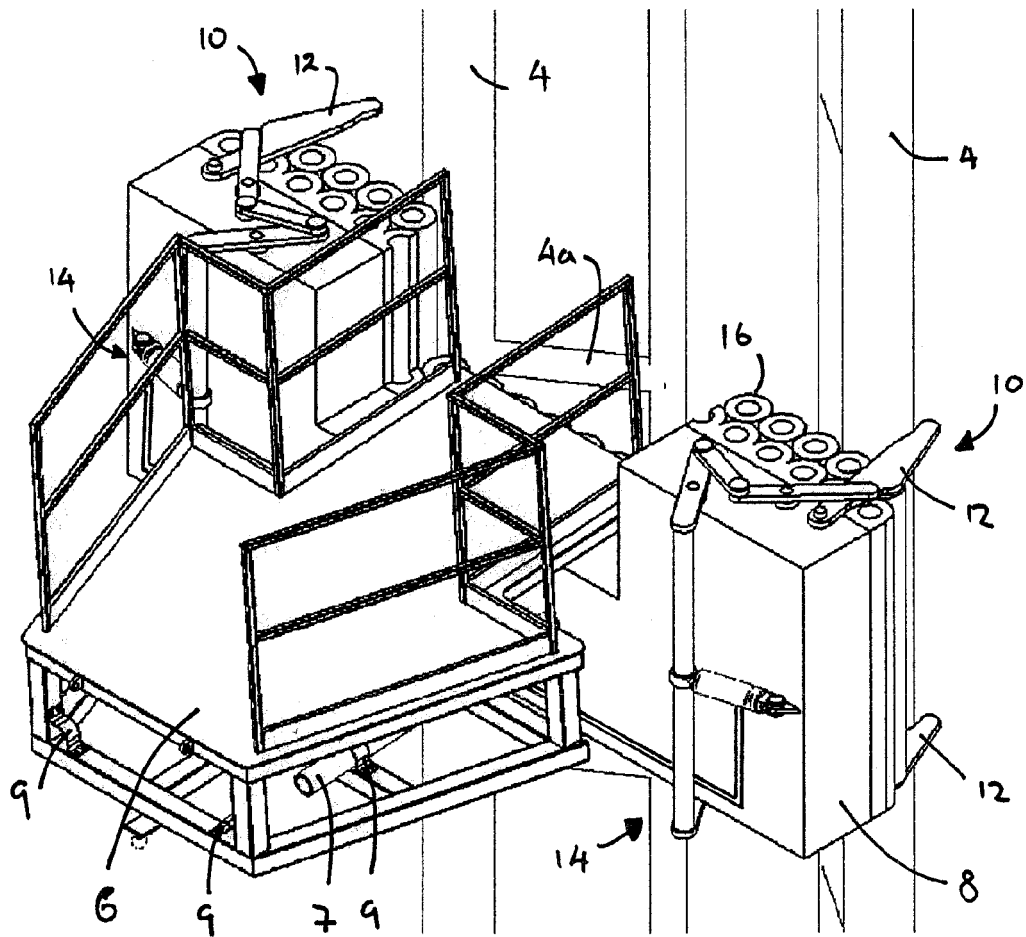


Figure 2a

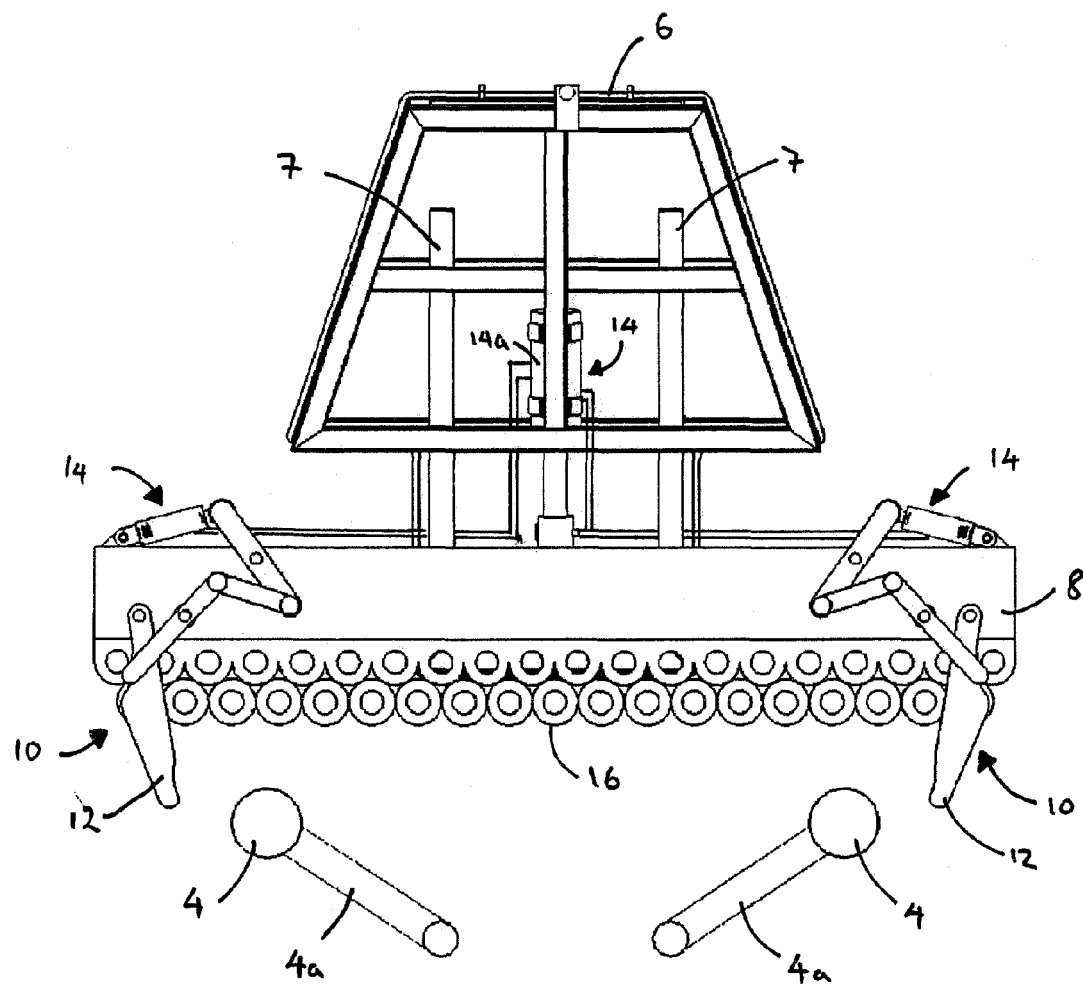


Figure 2b

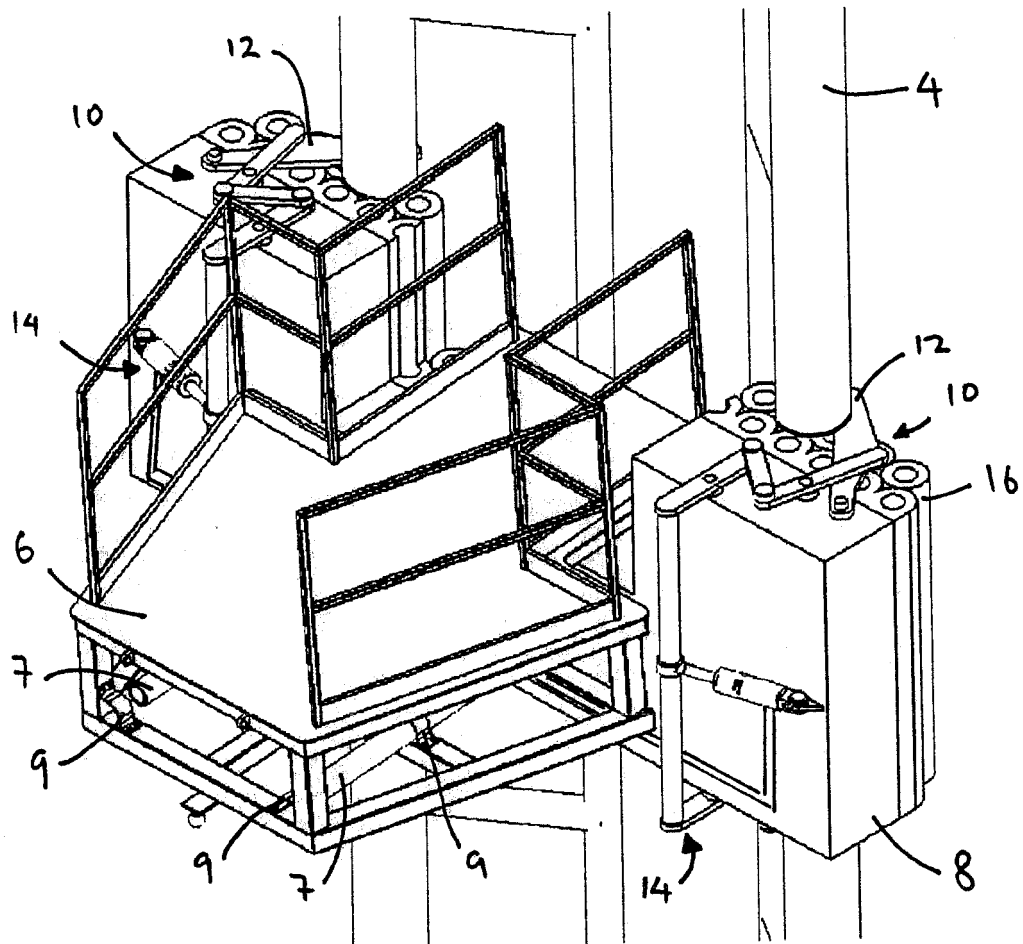


Figure 3a

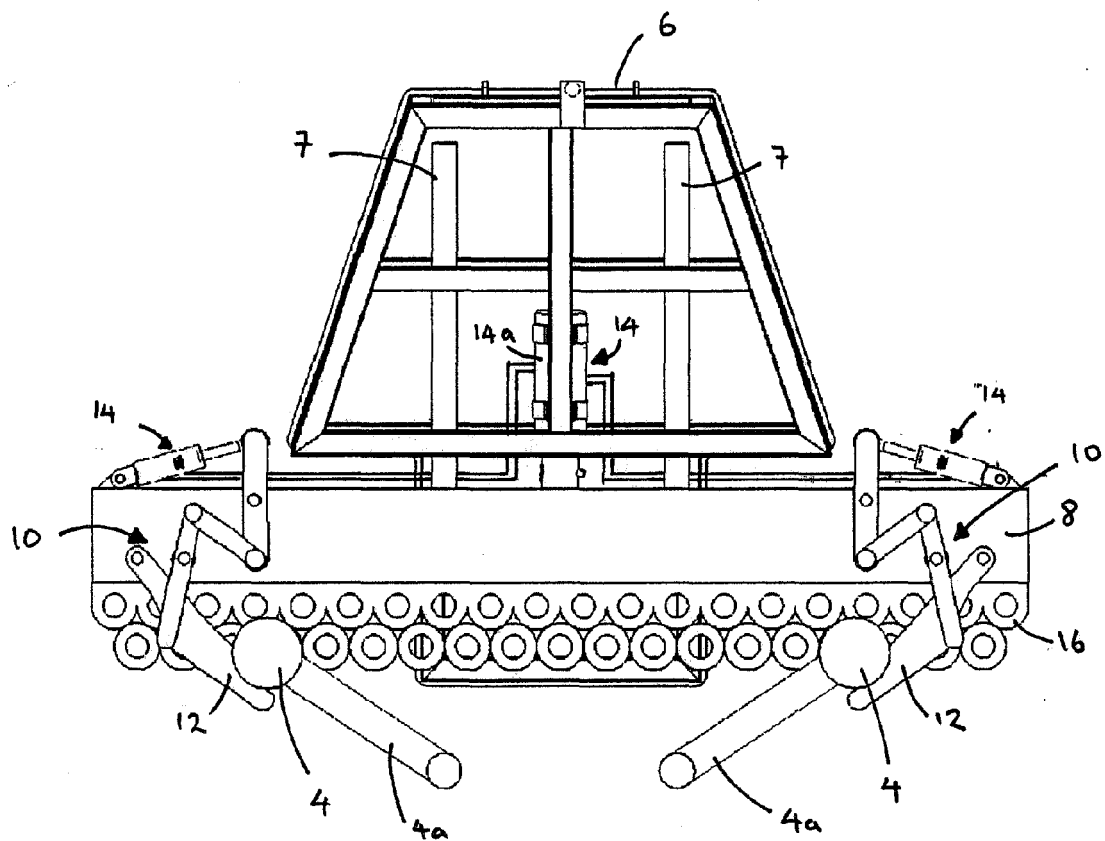


Figure 3b

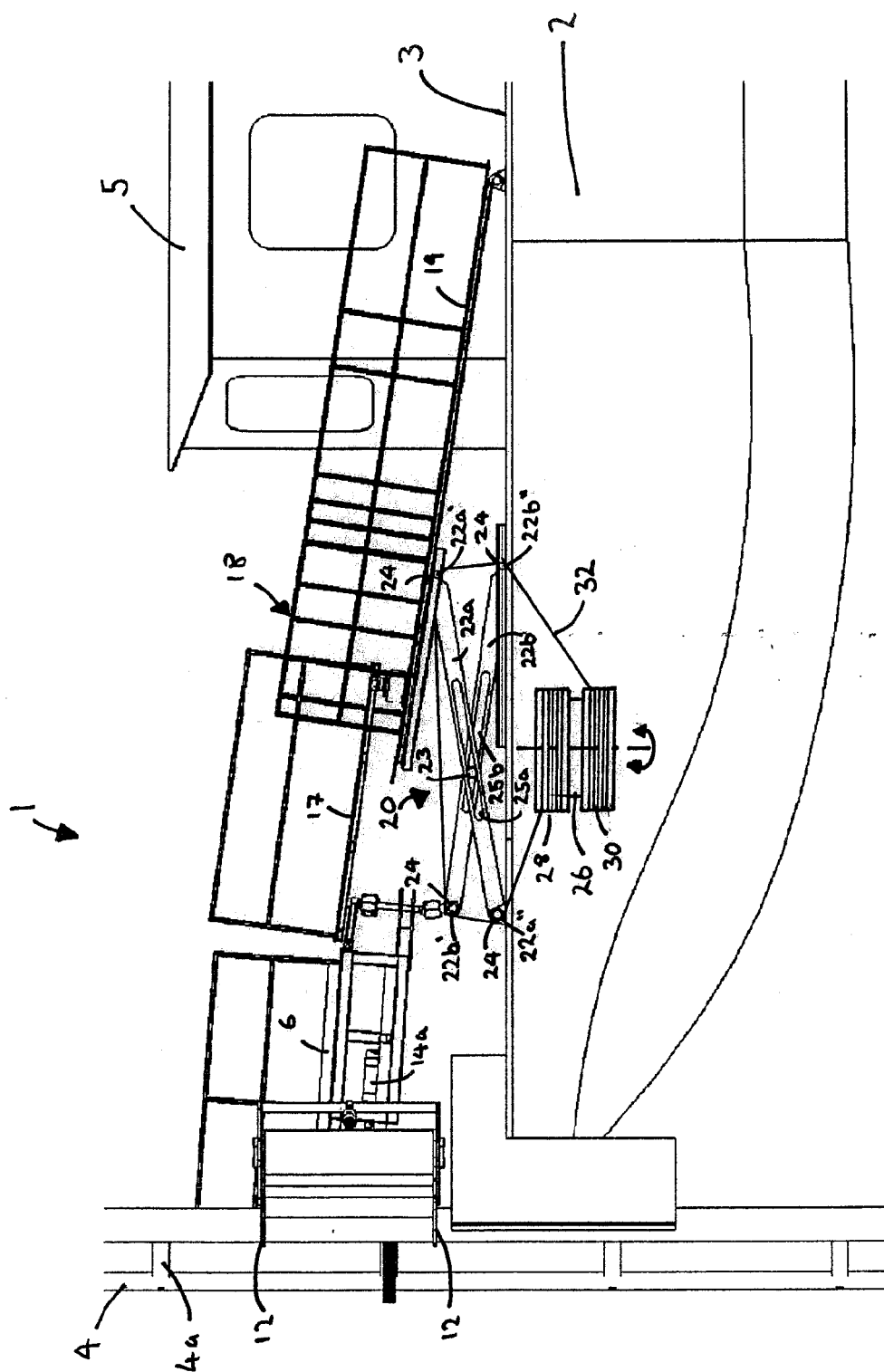


Figure 4

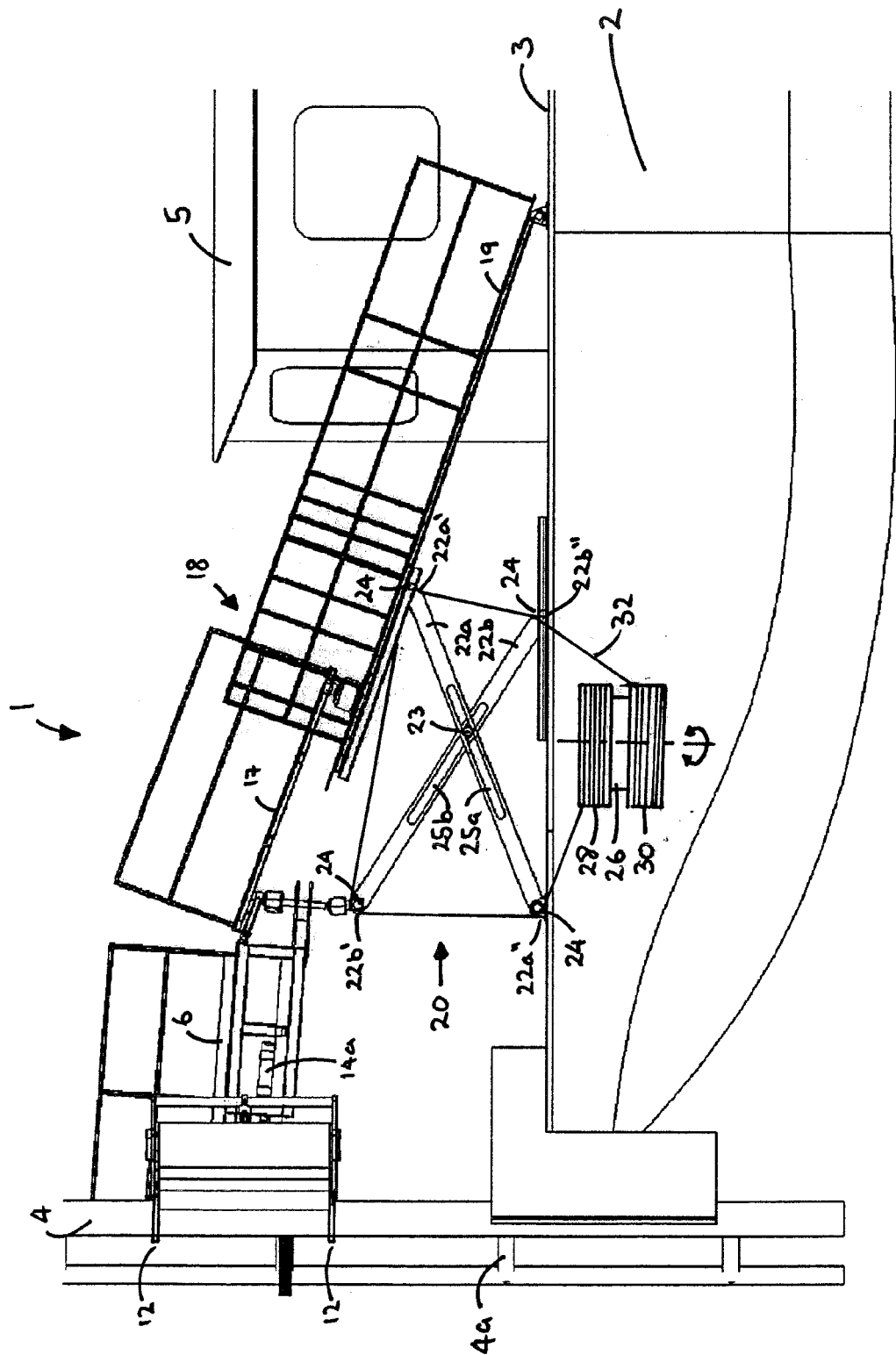


Figure 5

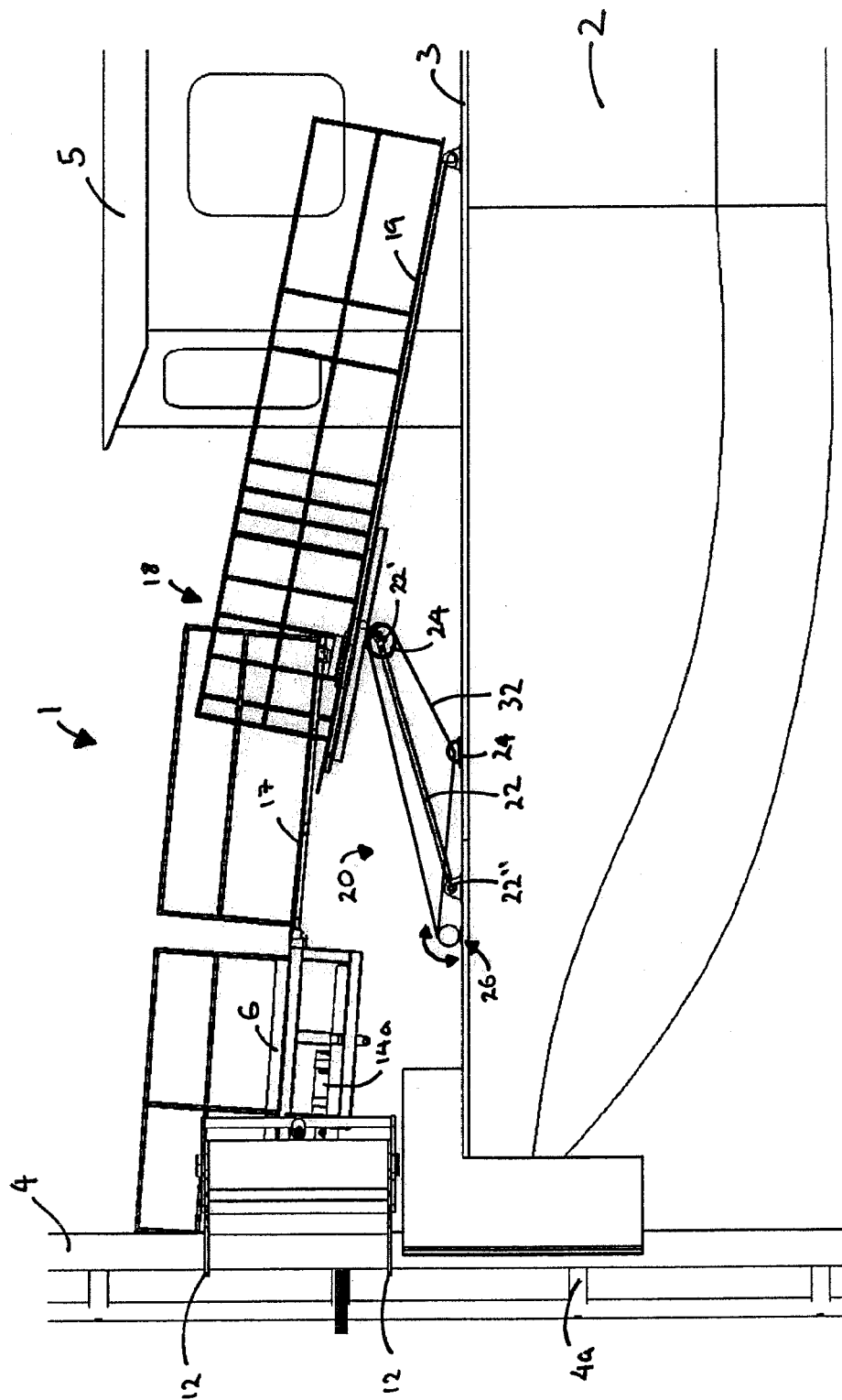


Figure 6

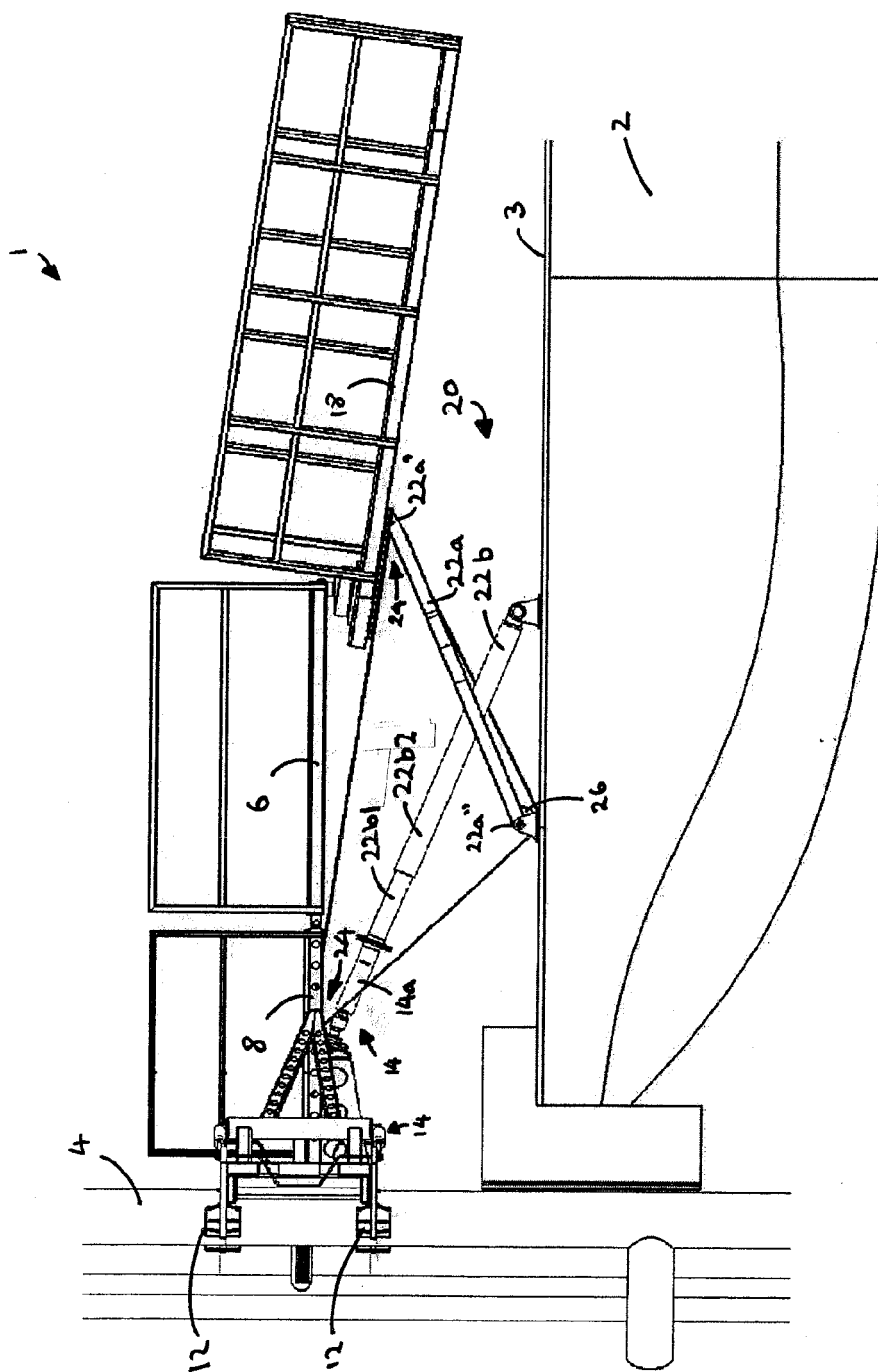


Figure 7

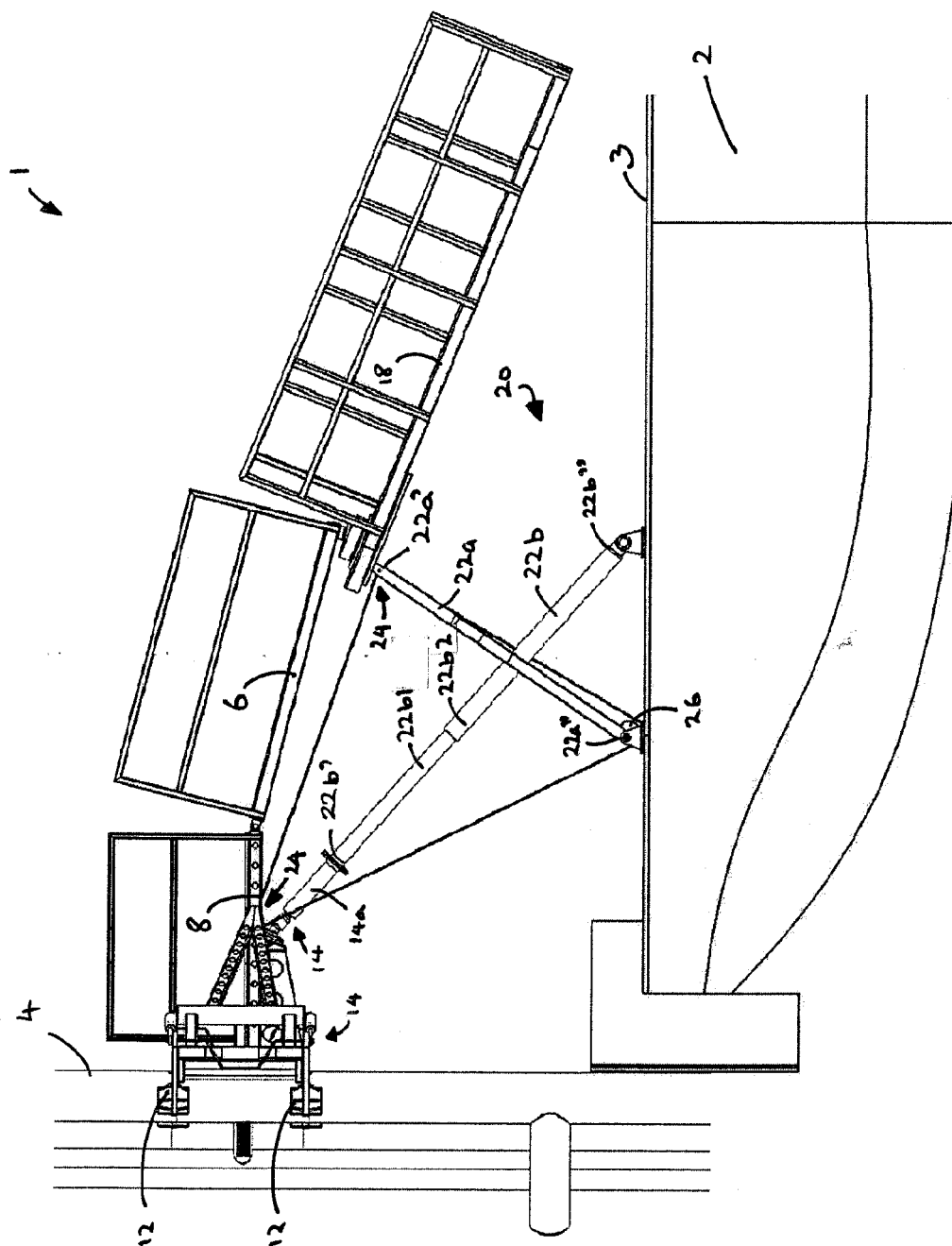


Figure 8

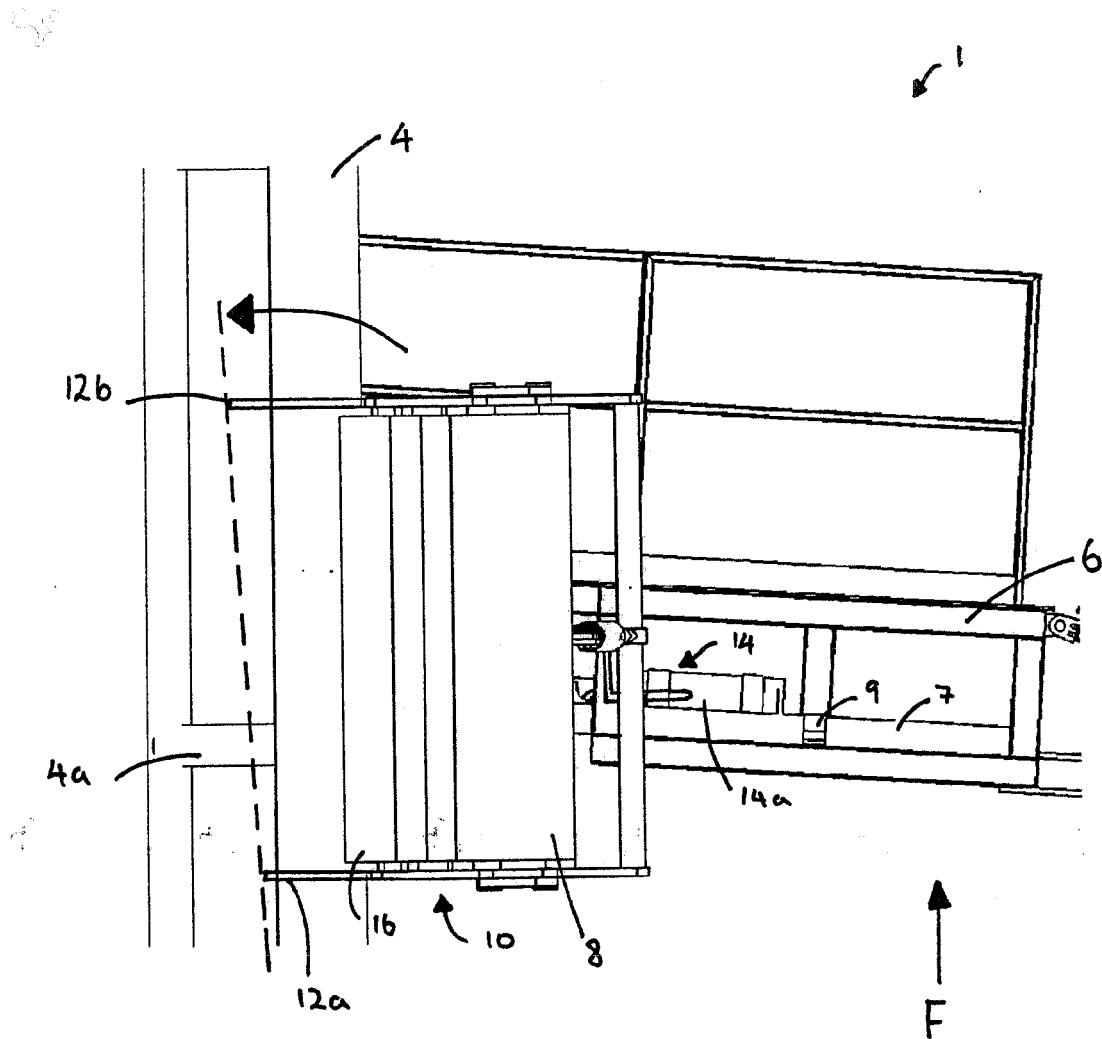


Figure 9

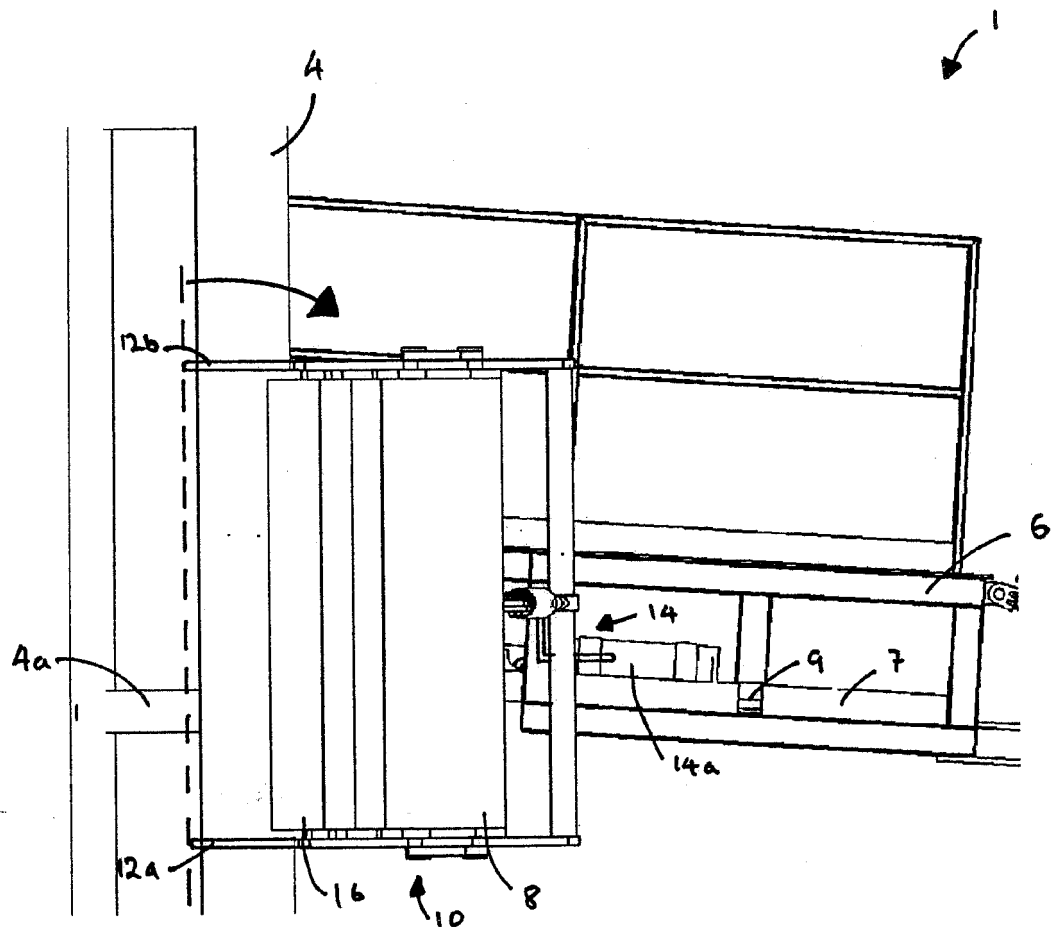


Figure 10

REFERENCES CITED IN THE DESCRIPTION

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