

A MOBILE DOCKING APPARATUS AND METHOD OF OPERATING THEREOF

Field

The present invention generally relates to a mobile docking apparatus and
5 method of operating thereof.

Background

When floating maritime assets, such as marine vessels, craft, boats, offshore
floating structures or offshore buoys or other floating objects and onshore and
10 offshore modules and structures (all collectively herein termed as
floating/transportable objects), need to undergo inspection, maintenance and
repair, (IMR) or other works, they are typically sailed and/or transported to a
nearest suitable shipyard for docking so that underwater IMR works may be
undertaken. This means that the assets are "off-hired" or demobilized from their
15 original worksites, and in some cases require the mobilization of replacement
assets which may or may not be available (in place of the assets being sent for
repair) to continue the contracted work, rather than halting operations.
Minimizing downtime by having ready access to a docking facility in the close
vicinity of the area of operations would be greatly advantageous. This requires a
20 docking facility that can be feasibly deployable.

Besides the above, the development of any green-field shipyards commands
relatively high investment both in terms of time and money (i.e. CAPEX cost). A
functional shipyard requires a combination of alongside berths and docking
25 facilities. Perhaps with the exception of floating docks (in its role as a docking
facilities vis-à-vis a jetty), these facilities are usually fixed civil installation
located at the land/foreshore interface. The above factors hence increase a
higher risk exposure for developing countries. However, in more developed
countries, stringent compliances for environmental protection are becoming ever
30 tougher or satisfactory waterfront areas are becoming more difficult to be
secured at a commercially viable cost. Therefore where shipyards are needed,
one can appreciate the higher investment risk in developing countries and the
higher barrier to entry for shipyard businesses due to the environment and costs
factors in developed countries. These are some of the negative factors that
35 make investment for green-field shipyards more difficult and challenging.

Additionally, conventional docking methods (e.g. slipways, semi-submersible barges/vessels, ship-lifts, floating docks, and graving docks) are obviously not mobile, and require semi-permanent or permanent civil marine infrastructures.

5 By way of the following illustrating examples:

(i). a ship-lift requires two piers or one quay depending on its positioning to accommodate associated winches used for raising the lifting platform and for docking/undocking operations. Both the costs and time investment to construct
10 these piers and quays are high. Also lifting platforms used by the ship-lift are generally made of heavy steel, with no buoyancy capability, i.e. has no lifting capacity other than from mechanical means (e.g. winches and etc.) without much assistance from the buoyancy tanks.

15 (ii). a floating dock requires an anchoring system comprising mooring winches with anchors and chains and/or, spud pipes, or dolphin pier(s), to hold the floating dock in secure position for safe docking/undocking operations.

(iii). a semi-submersible heavy-lift barge, which is intended for transportation,
20 and to some extent for carrying out IMR works. Once reconfigured, the submersible barge has greater flexibility than a floating dock, since the submersible barge is also mobile.

(iv). a self-propelled heavy semi-submersible vessel that may be employed to
25 lift vessels from different location(s). This, however, is a very expensive operation and the utility of the self-propelled heavy lift vessel is limited to a means of transportation and not in an environment in which to execute the work necessitating for docking the vessel to be transported.

30 (v). a graving dock is a complex and fixed civil construct created on the foreshore area and required on land. Prior geotechnical studies on land to check for soil stability and seabed investigation are necessary, before the graving dock is built. Highly intensive civil works will involve pile foundations, concrete dock floor and walls construction, dock gate entrance and sill
35 development, building of a caisson gate, installation of the necessary pumps and

5 pump-rooms. It is to be appreciated that finding a suitable location for building the graving dock will typically be a challenging compromise. An area that has appropriate supporting industrial base and the desirable solid rock, sea bed conditions (that requires less piling work to be performed), with a deep waterfront and approach channels to enable safe vessel entry is typically a rare combination.

10 Further, traditional ship breaking yards namely in the sub-continental area tend to conduct primary cutting of sides of vessels on shore (sometime slipways) or which are mostly carried out in an inter-tidal zone. Plates/blocks that are cutoff often dropped to the inter-tidal zone and are to be dragged ashore. Pollutants (e.g. residue oil, toxic paint residues, other undesirable waste materials and etc.) may be released into the surrounding river/sea water during this stage, causing pollution. Moreover, level-luffing cranes or other cranes that may safely
15 be operated in the berth and/or inter-tidal zone are generally not used during the primary cutting stage, which makes such demolition operations not only environmentally unfriendly, and unproductive, but also more difficult and dangerous. So for green ship-recycling, designating a specific work zone where the vessel can be contained in a dry area away from the inter-tidal zone during
20 the demolition phase would be ideal.

Yet further, apart from the IMR operations, many offshore services including, construction, installation, e.g. dredging, pipe-laying, sub-seas operations, wind turbine installation and repairs, salvage operations, emergency rescue
25 operations, oil/gas drilling and production, offshore piling and pipe/cable laying, offshore tender platform during drilling/maintenance, and other after through-life field services, where the current assets are deployed, may need their own support such as heavy lift floating cranes, floating barges as warehouses for logistical support and accommodation work barges for crew accommodations.

30 One object of the present invention is therefore to address at least one of the problems of the prior art and/or to provide a choice that is useful in the art.

Summary

According to a 1st aspect of the invention, there is provided a mobile docking apparatus comprising: a platform arranged to receive at least one floating/transportable object; and a plurality of supporting legs movably coupled
5 to the platform and configurable to be lowered to the seabed to anchor and/or support the apparatus. The platform is operable cooperatively with the lowered supporting legs to be adaptively raised or lowered with reference to a water-level to receive and lift the object.

10 Beneficially, the apparatus is operable so that the platform may be lifted up above the water-level under all tidal conditions for self-docking, and performing maintenance to the underbelly sections of the platform. For the self-docking capability, the apparatus is configured with self-installing capacity, where the apparatus is arranged to allow for self-installation without requiring further
15 extensive site work.

Advantageously, the docking apparatus is configured with the platform and supporting legs and footings to dock and lift a vessel out of water, and therefore beneficially means that the vessel need not be sailed to a shipyard for
20 inspection/repair/maintenance operations; rather the said operations may conveniently be carried out in the area of vessel's current operation.

Preferably, the apparatus may further include a pair of hull portions respectively arranged at the port and starboard side of the platform.

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Preferably, the hull portions may be integral with the platform.

Preferably, the apparatus may further comprise a plurality of ballast tanks arranged in the platform and/or the hull portions, which are operable for
30 adjusting a buoyancy of the apparatus to enable the platform to be adaptively raised or lowered.

Preferably, the supporting legs may include being arranged at the hull portions.

Preferably, the supporting legs may include at least two pairs of supporting legs respectively arranged at each hull portion.

5 Preferably, at least one of the hull portions may be configurable with at least one lifting crane.

Preferably, the apparatus may further include a set of guiding tracks arranged at the hull portions, wherein the at least one lifting crane is operable to be movable along the guiding tracks.

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Preferably, the apparatus may further comprise at least one extension platform having a collapsible arrangement.

15 Preferably, the apparatus may further comprise a plurality of sensors configured to monitor for structural integrity of the apparatus.

Preferably, the object may be a vessel and each hull portion may be configured with a ramp door to facilitate loading and/or unloading of cargo from the docked vessel.

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Preferably, the apparatus may further comprise at least one passageway arranged within the platform to enable access between the pair of hull portions.

25 Preferably, the apparatus may further comprise at least one collection-well arranged in the platform, wherein the platform includes a plurality of platform sections cooperatively arranged at respective angles to the longitudinal axis of the platform to enable fluid waste materials to be drained towards the collection-well.

30 Preferably, the supporting legs may include respective spud cans movably arranged to substantially stabilize the anchored apparatus against the seabed, when the supporting legs are lowered.

Preferably, each supporting leg may include at least a first drive unit hydraulically operable to raise or lower the platform, and the first drive unit is part of a hydraulic ring beam lifting system.

- 5 Preferably, each supporting leg may include at least a second drive unit electrically operable to raise or lower the corresponding supporting leg, and the second drive unit is part of a rack and pinion gear-lifting system.

10 Preferably, the second drive unit may be configured to be operated based on a rack-and-pinion arrangement, and an associated driving gear.

Preferably, the apparatus may further comprise at least one water propulsion device to propel the apparatus.

- 15 Preferably, wherein the supporting legs are configurable may include being arranged to be ballastible to enable the supporting legs to be lowered to the seabed.

20 Preferably, the apparatus may further comprise respective locking devices configured to releasably lock the respective supporting legs in position, relative to the platform.

25 Preferably, the apparatus may further comprise a plurality of station keeping devices used in conjunction with the lowered supporting legs to securely anchor the apparatus to the seabed.

Preferably, the station keeping devices may include a spread mooring system.

30 Yet further, the station keeping devices may also include a plurality of thrusters arranged with or without dynamic positioning configuration.

35 According to a 2nd aspect of the invention, there is provided a method of operating a mobile docking apparatus, which includes a platform arranged to receive at least one floating/transportable object, and a plurality of supporting legs movably coupled to the platform. The method comprises configuring the

supporting legs to be lowered to the seabed to anchor and/or support the apparatus; and operating the platform cooperatively with the lowered supporting legs to adaptively raise or lower the platform with reference to a water-level to receive and lift the object.

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It should be apparent that features relating to one aspect of the invention may also be applicable to the other aspects of the invention.

These and other aspects of the invention will be apparent from and elucidated
10 with reference to the embodiments described hereinafter.

Brief Description of the Drawings

Embodiments of the invention are disclosed hereinafter with reference to the accompanying drawings, in which:

15 FIG. 1a is a perspective view of a mobile docking apparatus, according to an embodiment;

FIG. 1b is a side elevation view of the docking apparatus of FIG. 1a, viewing in a direction from the starboard side to the port side of the apparatus;

FIG. 1c is an elevation view of the docking apparatus of FIG. 1a;

20 FIG. 1d is a plan view of the docking apparatus of FIG. 1a;

FIG. 2 is an elevation view of a pair of wing hulls of the docking apparatus of FIG. 1a;

FIGs. 3a and 3b respectively show a recess housing arranged at the wing hull for accommodating a spud can foot of a supporting leg of the docking apparatus
25 of FIG. 1a;

FIG. 4a is a sectional view of the docking apparatus of FIG. 1a, further configured with a plurality of lifting cranes;

FIG. 4b is a side elevation view of FIG. 4a;

FIG. 5 is an elevation view of a platform of the docking apparatus of FIG. 1a, showing a ramp door arranged at one of the wing hulls to facilitate side
30 embarkation and cargo loading/unloading;

FIG. 6 is a plan view of the platform of the docking apparatus of FIG. 1a;

FIG. 7 includes FIGs. 7a and 7b, which respectively show a front elevation view and a side elevation view of the platform of FIG. 6;

35 FIG. 8 is a cross-sectional view of FIG. 1a;

FIG. 9 is a front elevation view of the docking apparatus of FIG. 1a, further configured with a movable collapsible shelter/roof that may be integrated with a gantry crane;

5 FIG. 10 includes FIGs. 10a and 10b, which respectively show operation of a spud can foot of a supporting leg of the docking apparatus of FIG. 1a, immediately prior and subsequent to being anchored at the seabed;

FIG. 11 shows a plurality of electrical drive units arranged at a supporting leg of the docking apparatus of FIG. 1a;

10 FIG. 12 shows a plurality of hydraulic lifting units arranged at a supporting leg of the docking apparatus of FIG. 1a;

FIG. 13 includes FIGs. 13a to 13e, which collectively illustrate how the docking apparatus of FIG. 1a is operated in a full-floating mode;

15 FIG. 14 includes FIGs. 14a to 14f, which collectively illustrate an installation phase of the docking apparatus of FIG. 1a, when operated in a full-Jack-up mode;

FIG. 15 includes FIGs. 15a to 15d, which collectively illustrate an operation phase of the docking apparatus of FIG. 1a, after the installation phase is completed;

20 FIGs. 16 and 17 illustrate how the docking apparatus of FIG. 1a is operated in respective first and second modes of a hybrid mode operation;

FIG. 18 includes FIGs. 18a to 18d, which collectively illustrate an installation phase of the docking apparatus of FIG. 1a, when operated in a hybrid mode without the jacking system;

25 FIG. 19 includes FIGs. 19a to 19c, in which FIGs. 19a and 19b are prior art and FIG. 19c depicts the advantage of docking apparatus of FIG. 1a when used in the hybrid mode; and

FIG. 20 includes FIGs. 20a and 20b, which respectively depict the docking apparatus of FIG. 1a, operating in the hybrid mode with the jacking system freed and, used as a floating jetty and a mobile shipyard.

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Detailed Description of Preferred Embodiments

1. Overview of Main Features and Mode of Operations

35 FIG. 1a shows a mobile docking apparatus 100, according to an embodiment. In particular, the docking apparatus 100 is for receiving at least one floating/transportable object (not shown) disposed in water (e.g. in rivers/seas),

and the definition of “floating/transportable object” refers to any maritime boats/crafts/vessels of all types/offshore asset(s). But for description simplicity in this embodiment, a vessel is used as an example of the floating/transportable object. FIGs. 1b to 1d respectively show the side elevation view, front elevation view and plan view of the docking apparatus 100. It is to be appreciated that the docking apparatus 100 may be commercially named as a “Lift-DocTM” system, and is meant to be a “Beyond Docking” concept. The term “mobile” in mobile docking apparatus 100 means that the docking apparatus 100 is not and may not be permanently fixed to a dock/jetty/shipyard, unlike conventional solutions – the docking apparatus 100 (which floats) is instead movable (by being self-propellable/towable) on water to a desired location anywhere required. It is to be appreciated that in other instances, the docking apparatus 100 may also further be known as a “mobile lifting and docking apparatus”. The term “lifting” in this context means that the docking apparatus 100, while similar to a floating dock may be raised above a water-level, is however also different to the floating dock and a semi-submersible heavy lift barge wherein the docking apparatus 100 (which is arranged to float by means of its designed buoyancy capacity) is further and instead able to lift itself bodily upward and with the vessel (if required) above the water-level to a desired elevation.

Broadly, the docking apparatus 100 comprises a platform 102 arranged to receive the vessel; and a plurality of supporting legs 104 (which include associated leg footings – spud cans 300) movably coupled to the platform 102 and configurable to be lowered to the seabed to anchor and/or support the docking apparatus 100. Each supporting leg 104 is movable between a retracted position and a deployed position (i.e. in the lowered configuration). The docking apparatus 100 further includes a pair of (first and second) hull portions 106a, 106b respectively arranged at the starboard and port side of the platform 102. The platform 102 and hull portions 106a, 106b (arranged with leg-housings and jacking houses 108 for the supporting legs 104, together with the supporting legs 104), together collectively form the hull of the docking apparatus 100. In this instance, the hull portions 106a, 106b are detachably and mechanically coupled to the platform 102. The hull, which has a generally U-shaped cross-sectional arrangement (i.e. configured as a horizontal portion with adjoining transverse side-walls) and a rectangular arrangement, when viewed

from the top, is configured to be operable cooperatively with the lowered supporting legs 104 so that the platform 102 is raised or lowered with reference to a water-level to receive and lift the vessel out of water. Indeed, the U-shaped arrangement of the hull of the docking apparatus 100 serves as a dock to allow
5 the vessel to be fully received and accommodated within the docking apparatus 100, as will be appreciated from FIG. 1a. More specifically, each hull portion 106a, 106b is substantially rectangular and longitudinal in configuration, but is not to be construed as the only configuration possible. The hull portions 106a, 106b are securely attached to respective adjoining side-walls of the U-shaped
10 platform 102. It is to be appreciated that the (extended) hull portions 106a, 106b may alternatively be termed as extended wing hulls. At each hull portion 106a, 106b, there are two or more spaced apart leg housings (respectively located in the vicinity of the front and back ends of the associated hull portion 106a, 106b) that are each configured to movably receive a supporting leg 104, and
15 accordingly, the docking apparatus 100 thus has a total of four supporting legs 104 in this instance, but however is not to be construed as limiting. Each leg-housing which is centrally arranged with an associated receptacle, comprises an upper leg guiding portion and a lower leg guiding portion underneath thereto. An associated jacking house 108 is then arranged on top of each leg-housing, the
20 purpose of which will be explained below. A main ramp door 109 is pivotably arranged at the entrance to the hull (at the bow) of the docking apparatus 100, in which the ramp door 109 is deployed in a lowered-down configuration, when a vessel is to be received and docked into the docking apparatus 100; otherwise, the ramp door 109 is normally in an upright elevated configuration when not in
25 use. As will be seen in FIG. 1, the supporting legs 104 are movably coupled to the platform 102 via the hull portions 106a, 106b. More details on respective components of the docking apparatus 100 are provided below.

2. Extended Wing Hulls

30 Within each hull portion 106a, 106b, there is arranged a plurality of (large capacity) ballast tanks 202 to enhance and provide controllable buoyancy for the docking apparatus 100 and hence its lifting capacity, and a plurality of void spaces 204 (which may be configured to function as working/operating, and living spaces for crew members of the docking apparatus 100), as shown in FIG.
35 2. In this embodiment, the ballast tanks 202 and void spaces 204 are arranged

in a vertically stacked configuration, in which the void spaces 204 are arranged on top of the ballast tanks 202. This may be viewed as the horizontal compartmentalization of the hull portion 106a, 106b. Particularly, the ballast tanks 202 are positioned below a submerged waterline, whereas the void spaces
5 204 are arranged to be located above the submerged waterline. It is to be appreciated that the waterline is defined to be a sea/river water level of the sea/river in which the docking apparatus 100 is deployed. Specifically, the ballast tanks 202 are operable to accept and to be filled with sea/river water for adjusting an overall submergence/buoyancy of the docking apparatus 100 to
10 enable the platform 102 to be lowered. Similarly, discharging sea/river water from the filled ballast tanks 202 also conversely affects the buoyancy of the docking apparatus 100 by providing buoyancy lift to raise the platform 102 of the docking apparatus 100. In this manner, the ballast tanks 202 together with ballast tanks 600 of the platform 102 thus function as buoyancy tanks of the
15 docking apparatus 100 to enable the platform 102 to be lifted or lowered, whereas the supporting legs 104 and jacking houses 108 allow the docking apparatus 100 to be elevated above a water-level. Additionally, each hull portion 106a, 106b is arranged with a trapezium-shaped like section 206, extending outwardly at a side of the corresponding hull portion 106a, 106b
20 opposite to the side coupled to the platform 102. Specifically, the trapezium-shaped like section 206 (which is configured with at least one ballast tank 202) further enhances the buoyancy of the associated hull portion 106a, 106b. Also, when the supporting legs 104 with respective spud cans 300 are anchored securely to the seabed, both the hulls portions 106a, 106b on the port and
25 starboard sides may collectively function as respective berthing piers on both port and starboard sides of the docking apparatus 100.

On the other hand, each hull portion 106a, 106b is further logically sub-divided into a forward compartment, a middle compartment and an aft compartment.
30 This may be viewed as the vertical compartmentalization of each hull portion 106a, 106b. Broadly, the middle compartment is suitably zoned (as necessary) to function as consumable tank(s), wastage tank(s), machinery room(s), control room(s), the ballast tanks 202 (which are arranged to take in sea-water via the sea-chest and sea-water tower tank when required for submerging the platform
35 102), or the like. An eco-friendly green wastage management system may be

arranged in the middle or aft compartment of each hull portion 106a, 106b, wherein the said system operates cooperatively with the platform 102 to collect fluid waste materials, as will be described later below. The forward and aft compartments are then zoned to accommodate respective trim-adjustment-and-jack housing/gearing machineries/jack-cases, and optional recess housings for storing associated legs/footings of varying size and different types of spud cans (footings) 300 of the supporting legs 104 (when held in the retracted position, i.e. see FIGs. 3a and 3b). The optional recess housings are located at the lower leg guides of respective receptacles of corresponding leg-housings. It is to be appreciated that the jacking/gearing machineries arranged in the upper and lower jack-cases of the jacking houses 108 enable the supporting legs 104 to be operable between the retracted and deployed positions. So, the docking apparatus 100 is beneficially configurable to be transported anywhere required (i.e. when all the supporting legs 104 are arranged in the retracted position) and as well as being able to be anchored to a worksite by deploying the supporting legs 104 (i.e. via use the jacking/gearing machineries to deploy the supporting legs 104, and/or self-lift the platform 102).

Optionally, a plurality of monitoring sensors (not shown) are suitably deployed at the respective mentioned jacking houses 108, compartments of each hull portion 106a, 106b to allow continuous monitoring of overall structural integrity of the docking apparatus 100 to ensure that the docking apparatus 100 is not unduly stressed to structural failure during operation, for safety reasons. Specifically, the sensors are configured to monitor for sagging, hogging, twist stresses, bending stress or other stress forces, which are imposed on the jacking houses 108 and the docking apparatus 100 during lifting/docking operations.

From FIGs. 4a and 4b, it can be seen that different types of lifting cranes of varying lifting capacities (e.g. leg encircling crane, travelling luffing cranes or fixed luffing or tower cranes, gantry cranes and etc.) and/or deck machineries may be fitted atop of the hull portions 106a, 106b, and also at the jacking houses 108 holding the supporting legs 104 to facilitate internal cargo loading/unloading and external cargo transportation to/from the vessel docked at the docking apparatus 100. Moreover, other types of lifting cranes may be accommodated on the docking apparatus 100, but not at the top of the hull portions 106a, 106b,

such as fixed marine/offshore cranes, gantry cranes (which are movable on guiding tracks), marine/offshore leg encircling cranes, or the like.

5 To further enhance an overall lifting capacity and capability, the docking apparatus 100 may be outfitted with at least one set of cantilevered arms 400 respectively positioned at the stern and bow of the hull portions 106a, 106b to advantageously extend an operating zone for fitting a gantry crane. Particularly, the gantry crane is configurable to farther travel to the bow/stern of the hull portions 106a, 106b via the respective cantilever arms 400. The cantilever arms 10 400 thus serve as extension platforms for the hull portions 106a, 106b. It is to be appreciated that the cantilevered arms 400 are fixed and/or collapsible and thus may be stowed for storage, if not being used.

15 With reference to FIG. 5, each hull portion 106a, 106b is further arranged with external and internal fenders 500a, 500b to protect the docking apparatus 100 from sustaining internal when docking and/or external damage during berthing/unberthing, loading/unloading, or embarking/disembarking operations. Further, each hull portion 106a, 106b is arranged with at least a specially designed large side opening sized to accommodate a retractable ramp door 502 20 to facilitate side embarking, side transfer of cargo from barge/landing crafts to/from the vessel at the port and/or starboard side of the docking apparatus 100.

25 Based on different requirements of intended applications, other optional add-on components and accessories may be applied to the hull portions 106a, 106b may include, but not limited to, the following: various types of cranes (e.g. leg-encircling cranes), a helideck, an external communication antennae and weather station, water propulsion and/or thruster devices (e.g. jet-thrusters) to enable the docking apparatus 100 to be self-propellable. More specifically, installing the 30 water propulsion and/or thrusting devices allow for more accurate positioning of the docking apparatus 100 (i.e. station-keeping) at designated sensitive offshore locations when required. The docking apparatus 100 may also be appropriately reconfigured for applications such as highly specialised painting and metal spraying operations to be carried out on a docked vessel by incorporating a full

or partial sheltered enclosure arrangement for quality of paint work to protect workers from weather elements during performance of those operations.

3. Self-Buoyant Platform

5 The plan view of the platform 102 of the docking apparatus 100 is shown in FIG. 6. As aforementioned, the hull of the docking apparatus 100 is generally of a U-shape configuration as seen from FIG. 7a, in which the platform 102 is coupled at its respective adjoining side-walls to the hull portions 106a, 106b. Similar to the hull portions 106a, 106b, a plurality of pontoon tanks 600 (in the form of
10 pontoon double bottom tanks configured side-by-side) are arranged within at the forward, mid-part, and aft sections of the platform 102. From the plan view in FIG. 6, the platform 102 is seen to be of a rectangular shaped and have the pontoon tanks 600 joined to the forward, mid-part and aft section of the hull portions 106a, 106b to act as buoyancy tanks and hence contribute to the total
15 reserve buoyancy capacity of the docking apparatus 100. Advantageously, such an arrangement provides better integration of the platform 102 with the pontoon tanks 600, and by using the longitudinal and transverse beam structures to form strength members to the platform 102, a number of moon-pools 110 may also be provided on the platform 102 (to be elaborated below). The platform 102 with the
20 hull portions 106a, 106b also provide better structural strengthening to the platform 102 as well. This also means that by adjusting the buoyancy of the platform 102 (via the pontoon tanks 600), the docking apparatus 100 is able to self-lift marine assets onsite (without use of external machineries) for carrying out inspection, maintenance and repair works simply using the buoyancy effect,
25 hence lifting the marine assets to work. The platform 102 further includes the plurality of moon-pools 110 (i.e. at least two), which are primarily used to provide access for repairing/changing out/overhauling the water propulsion and/or thrusting devices (if any are fitted) and also are able to function as wave-breakers to provide the docking apparatus 100 with the ability to operate/survive
30 in rough weather/sea conditions. Specifically, when the docking apparatus 100 is in an elevated position above a water-level, the moon-pools 110 mitigate effects of tidal forces acting on the underside of the platform 102, which may otherwise undesirably lift the docking apparatus 100 off the supporting legs 104. The moon-pools 110 also enable repair/installation of all types of under-hull
35 appendages to the docking apparatus 100. The moon-pools 110 are arranged

with removal hatch-covers, and are coupled to the pontoon tanks 600, integrated with the longitudinal and transverse beam structures of the platform 102, and may all be covered with wood to form a wooden decking to provide the platform 102 (i.e. see FIG. 6). A pump room with a passageway is also arranged within, preferably at the mid-part section of the platform 102 to provide easy access between the (for example, different machinery/pump rooms of the) first and second hull portions 106a, 106b. That is, the pump room is located besides and/or between one of the pontoon tanks 600 situated below the deck of the platform 102. It is to be appreciated that the pump room is positioned transverse to the longitudinal axis of the platform 102. In addition, the passageway (provided through the pump room) can also serve as a connection tunnel between the hull portions 106a 106b and the pump room is usable as a control station for accommodating pumps/pipe/valves/cable and trunkings used for ballast water, liquid transfer, holding/collection tanks, waste treatment/recycling facilities, and etc., as necessary.

The deck of the platform 102 is arranged to have a large unobstructed, open space for good layout area for the docked vessel, and also configured to have a high deck loading capacity. The design of the platform 102 is such that the combination of pontoon tanks 600 with the longitudinal and transverse structural beam structures covered with hard wood decking, if required, enables the platform 102 to be able to float on its own – hence resulting in a self-buoyant platform. The deck loading capacity of the docking apparatus 100 is at least equal to, if not greater than, the lifting capacity, while in designing the platform 102, consideration of the type of maritime assets/objects to be docked/received, and a desired floor area (i.e. foot-print over its weight) will also be taken into account. As will be appreciated, the platform 102 can have varying dimensions, in terms of associated length and width, to suit specialised applications intended at worksites (e.g. based on water depth) where the docking apparatus 100 is to be deployed. The platform 102 is not limited to be U-shaped, and other suitable forms are possible. Other equipment/plants/facilities may in addition be suitably installed on the deck of the platform 102 to conveniently allow any “on deck”, “under deck” and “below deck” operations, as required.

Yet further, the deck of the platform 102 is specially designed to facilitate fluid drainage to a waste fluid collection system. This allow for substantially automatic collection of fluid waste/debris materials (generated during repairing of a docked vessel) for waste treating/recycling, by way of the eco-friendly green wastage management system. Now referring to FIGs. 7a and 7b, two or more collection troughs leading to collection wells 700 are arranged at within various parts of the platform 102, and the collection wells 700 are configured to be in fluid communication with respective waste collection tanks (not shown). In this instance, the collection wells 700 at located substantially close to the port and starboard sides of the platform 102, although it need not be the case in variant embodiments. Accordingly, the deck of the platform 102 is formed from a collective plurality of platform sections cooperatively and angularly arranged at respective appropriate angles to the longitudinal axis of the platform 102, such that the platform sections are arranged to slope towards the respective collection troughs leading to the collection wells 700. Then using gravity assist, any fluid waste/debris materials residing on the platform 102 will naturally be drained towards the respective collection trough leading into the collection wells 700. This allows fluid waste/debris materials, washed waters, and suspended slurry to be washed-away into the collection troughs and be collected in the waste collection tanks for subsequent treating/recycling before being discharged.

Considering that a high deck load will be likely imposed on the platform 102 with a variety of vessels to be docked in the docking apparatus 100. Accordingly the decking of the platform sections will be reinforced with longitudinal and transverse truss-structured beam members. These members will also couple the platform 102 to the hull portions 106a, 106b (i.e. see FIG.6). Large scantling materials will be used for the solid deck floor and structural members to withstand twisting loads and heavy deck cargo. Hence the platform 102, which is built to withstand high deck loading, consequently allows the docking apparatus 100 to dock and lift substantially all types of floating assets/offshore units. Furthermore, the entire deck or a partial deck area of the platform 102 may be clad in hard wood decking if required for different applications and operations, as intended.

To enhance the capability of the platform 102 without sacrificing valuable deck space, there is also provided an option of installing a hydraulically operated dock side articulated dock-arms to aid with blasting/painting and other related work to be carried out at height from the deck of the platform 102. Moreover, as shown in FIG. 9, guiding tracks optionally installable on the hull portions 106a, 106b for gantry cranes may alternatively be used to install and/or for moveable collapsible shelters/roof 900, which can be useful in applications such as providing an enclosure for mega/super-yacht recoating and repair.

It is to be appreciated that the docking apparatus 100 may be utilised for a variety of work applications which include: providing accommodation, or functioning as a dry dock, as an enclosed shelter, as a water treatment facility, as a waste-recycling to energy system, as a painting station with dust extraction system, as a floating hospital facility, as a fishery command centre, as a freezing and processing factory, as a LNG portable terminal, and etc.

4. Jacking System with Supporting Legs and Spud cans

The supporting legs 104 are either tubular or trussed leg types. The former leg type has a columnar or square pipe cross-section profile, whereas the latter leg type is a truss-worked structure leg. Each supporting leg 104 is arranged with the spud can 300 at the foot of the associated supporting leg 104. The spud can 300 is designed to be ballastible or non-ballastible, depending on intended applications, and enables each supporting leg 104 to independently be deployed at slightly uneven seabed surfaces. Each supporting leg 104 is also configured to be ballastible by accepting sea/river water, which is useful in some operating modes to be elaborated in the section "*Functional Modes of Operations*" below. One distal end of the supporting leg 104 to be in contact with the seabed (when in the deployed position) may be arranged with a substantially pointed feature to allow the supporting leg 104 to more easily penetrate the surface of the seabed. The supporting legs 104 are first "soft-pinned" and preloading operation is subsequently commenced using the lightest condition, in which the ballast and pontoon tanks 202, 600 are ballasted. Specifically, careful effort is taken to ensure that the supporting legs 104 are taking equal loads during the preloading operation, and the preloading operation is stopped when there is no significant seabed movement detected on each of the supporting legs 104. The definition of soft-pining means that the supporting legs 104 and associated spud cans 300

are lowered to just merely touching the seabed surface, but not yet in an anchored state. Soft-pinning is carried out to assess and align positions of the lowered supported legs 104 relative to the hull of the docking apparatus 100 to ensure there is no significant seabed soil movement at the locale.

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An alternative technique involves performing soft pinning at high tide. This technique involves alternately locking a first pair of diametrically opposed, supporting legs 104 using a locking system provided in a jacking system of the docking apparatus 100. Hence, the full weight of the docking apparatus 100 is used to create leg penetration during tidal changes from high to low tide and this process is then repeated for a second pair of diagonally opposite supporting legs 104 to carry out the preloading operation for pinning to secure the docking apparatus 100 to the seabed. Once the preloading is completed, the docking apparatus 100 is carefully jacked out of the water until a desired pre-load air gap above the water-level is attained.

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Further, for the docking apparatus 100, two typical types of jacking systems may be used to raise/lower the platform 102, and raise/lower the supporting legs 104. The first method utilises a hydraulic ring beam lifting system, and the second method is based on a rack and pinion gear-lifting system arranged to be driven by electric or hydraulic motors. For the hydraulic ring beam lifting system, each supporting leg 104 is mechanically coupled to at least a first drive unit 1200 (i.e. a beam ring lifting device) hydraulically operable to raise/lower the platform 102 (i.e. see FIG. 12). In this case, the at least first drive unit 1200 includes two or more such drive units 1200.

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Then, for the rack and pinion gear-lifting system, each supporting leg 104 is further coupled to at least a second pinion drive unit 1100, in which more of the second pinion drive units 1100 may be arranged at certain layers of the supporting leg 104. Each second pinion drive unit 1100 is electrically operable to enable said supporting leg 104 to be lowered to the seabed (in the deployed position) to anchor the docking apparatus 100 (i.e. see FIG. 11). In this case, the at least second pinion drive unit 1100 includes a plurality of such drive units 1100. Based on different applications and load requirements, both the hydraulic ring beam lifting system (which uses a series of holes configured and spaced at

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different levels of the supporting legs 104 as securing pin/holes for the first drive units 1200 to latch and secure thereto), and rack and pinion gear-lifting system (which uses a rack and chord system) are used cooperatively for docking a vessel. So, the hydraulic ring beam lifting system, or the rack and pinion gear-lifting system (depending on which is used) is generally termed as a jacking system of the docking apparatus 100. Also, depending on a water depth at which the docking apparatus 100 is to be anchored, a suitable length, type and size of the supporting legs 104 may be deployed accordingly. As
5 aforementioned, it is noted that there are generally two types of supporting legs
10 104 available: i.e. tubular (e.g. circular or square) legs, or trussed legs (which are suitable for deeper water operations). .

To elaborate slightly on the rack and pinion gear-lifting system, it is a conventional jack-up system for raising or lowering the platform 102. As
15 mentioned, the rack and pinion gear-lifting system includes multiple of the second pinion drive units 1100, each of which is configured to be operated using a rack-and-pinion arrangement, through an associated driving gear and electrical motor/hydraulic rotor (see FIG. 11). It is to be appreciated that at different heights of each supporting leg 104, at least two second pinion drive units 1100
20 are arranged at each level, and certainly more of the second pinion drive units 1100 may be arranged at a particular level if required. So, it may be seen that there are multiple "layers" of the second pinion drive units 1100 in that sense. In particular, lifting tooth racks are integrally formed on respective supporting legs 104, and when the supporting legs 104 are to be lowered/raised, declutched
25 gears engage with the associated motors/rotors, which consequently causes the respective gears to engage with the associated lifting tooth rack to linearly guide the corresponding supporting leg 104 to move up/down within the associated receptacle of a corresponding leg-housing to attain the retracted/deployed position. Moreover, it is to be appreciated that the weight of each supporting leg
30 104 further aids the downward movement of the said supporting leg 104, during deployment by being lowered to the seabed.

The hydraulic ring beam lifting system is also a typical jack-up system that is only used for round/square cylindrical supporting legs (but not for trussed
35 supporting legs), which utilises a pin-based mechanism to collectively elevate

both the platform 102 and hull portions 106a, 106b above a water surface (i.e. see FIG. 12). That is, there is an air-gap separating the elevated platform 102 and hull portions 106a, 106b from the water surface. Needless to say, depending on rated payload requirements for the platform 102, two or more of
5 the first drive units 1200 are used in each supporting leg 104.

Then, the rack and pinion gear-lifting system deployed for both round pipe or trussed supporting legs include multiple of the second pinion drive units (having associated gearboxes) 1100 for each supporting leg 104. Rack teeth are
10 installed along the length of each supporting leg 104 and together with a guiding mechanism, the supporting legs 104 are guided to move up/down through the associated jacking houses 108 located in the hull portions 106a, 106b, via the rack teeth and pinions, which are in turn coupled to electric or hydraulic motors. It is to be appreciated that general operations of the hydraulic ring beam lifting
15 system, and rack and pinion gear-lifting system will be understood by skilled persons, and thus not further elaborated, other than what have been described above, for sake of brevity.

Similarly, when the docking apparatus 100 is securely anchored to the seabed
20 by the supporting legs 104 together with the spud cans 300, the hull portions 106a, 106b and the platform 102 is arranged to be in a free floating state, and thus moving up and down via the supporting legs 104 with the tidal changes. Hence, the hull of the docking apparatus 100 is moving up and down correspondingly in this manner. As such, the up and down movement of the hull
25 of the docking apparatus 100 may be harnessed to generate electrical energy using the hybrid motors (or alternators) via the pinions in the gear boxes (and is only for electrically driven pinion motors), and are then stored in the storage battery for later usage.

30 So in summary, the jacking system of the docking apparatus 100 is a jack-up system for elevating the platform 102, being installed in the respective jacking houses 108 at corresponding leg-housings (arranged in the hull portions 106a, 106b), and also for lowering and lifting the supporting legs 104 (configurable optionally with or without the spud cans 300), and in so doing, lifting and
35 lowering the platform 102.

Moreover, if the hull of the docking apparatus 100 is to be maintained in an elevated position above a water-level, the jacking system can also be installed with a leg locking device (which may include a mechanical/hydraulic locking mechanism). This locking device configured at each leg secures and holds the hull of the docking apparatus 100 in position when the hull has been lifted to a desired height above the water-level. In this way the supporting legs 104 with associated spud cans 300 are locked in position (relative to the platform 102), allowing the weight of the hull of docking apparatus 100 and its load to fully be transferred to the supporting legs 104.

It is to be appreciated that there are different types and sizes of footings (e.g. spud cans) usable for the supporting legs 104, but which type is to be deployed depends on a soil condition of the seabed at an envisaged worksite. When the docking apparatus 100 has arrived at the designated worksite, the supporting legs 104 with associated spud cans 300 are first lowered down to the seabed for initial positioning (i.e. FIG. 10a), and thereafter the respective spud cans 300 are lowered to be embedded in the seabed (i.e. FIG. 10b). At least two locking pins are then activated to securely lock the respective spud cans 300 to the associated supporting legs 104 to firmly anchor and substantially stabilise the docking apparatus 100 to the seabed. Conversely, when docking apparatus 100 is afloat, or that the spud cans 300 are not in use, the spud cans 300 may optionally be retracted to their stowage recesses within the housing located at the base, as above described with respect to FIGs. 3a and 3b.

5. Functional Modes of Operations

Broadly, a method of operating the docking apparatus 100 involves configuring the supporting legs 104 to be lowered to the seabed to first anchor and support the apparatus 100; and followed by operating the platform 102 cooperatively with the supporting legs 104 to raise or lower the platform 102, with reference to a water-level, to first receive and then lift the vessel out of water. Specifically, receiving the vessel into the docking apparatus 100 is described in more detail below, and it will be understood that subsequently, to re-launch the docked vessel back into the water, the reverse sequence of steps may be carried out in a *mutatis mutandis* manner.

In use, the docking apparatus 100 could be deployed to a required worksite in sea/river, and upon arrival, the supporting legs 104 are lowered to the seabed ready for anchoring the docking apparatus 100 thereto. At that juncture, the ballast tanks 202, 600 of the docking apparatus 100 are not yet filled, meaning
5 that the docking apparatus 100 is floating. Then, the ballast tanks 202, 600 are opened (in a controlled sequential manner) to accept seawater so that the docking apparatus 100 may be fully/partially submerged to a desired draft level (within the design limits of the docking apparatus 100). Hence, this results in the platform 102 (together with the hull portions 106a, 106b) being submerged to
10 the desired draft level. Next, a vessel at the worksite is towed towards, and to be docked at the docking apparatus 100. Alternatively, the docking apparatus 100 may first be positioned (using the water propulsion devices or towing winches) nearer in the vicinity of the vessel for greater convenience of operation.

15 Once the vessel is safely secured within the docking apparatus 100, de-ballasting of the ballast tanks 202, 600 is commenced to lift the docked vessel up to a level concurrent with the water level of the sea/river, or (if required) above the water level by further using the pin-lifting system. Therefore, the docking apparatus 100 may be operated (within designed payload limits) to lift
20 the docked vessel to a desired level to carry out necessary repair works. It should be noted while the docking apparatus 100 has not yet docked in a vessel, the docking apparatus 100 may be arranged to have the platform 102 (and the hull portions 106a, 106b) floating on water, while the supporting legs 104 are configured in the deployed position to anchor the docking apparatus 100, without
25 having to rely on using mooring spreads (i.e. anchors and anchor chains) as would conventionally be the case.

Further, when the platform 102 and the hull portions 106a, 106b are elevated to be above the water surface, and in situations of rough/high sea state conditions,
30 the air-gap, the large side openings of the hull portions 106a, 106b and the moon-pools of the platform 102 may collectively act as wave breakers to counteract the heavy sea waves. Consequently, this enables the supporting legs 104 to remain firmly secured to the seabed without experiencing the "jump-up" effect to damage the platform 102 and hull portions 106a, 106b. Moreover,
35 when underbelly sections of the platform 102 and hull portions 106a, 106b are

due for maintenance/inspection, the platform 102 and hull portions 106a, 106b can be elevated (to a desired height above the water surface) by the supporting legs 104 in a similar manner for above water inspection/repair.

5 Herein below, more specific operating modes of the docking apparatus 100 are described.

- ***Operating Mode-1***

10 In an Operating Mode-1 ("*Ops-1*"), the docking apparatus 100 functions similarly to a floating dock (arranged in a stationary position), or to a moving semisubmersible heavy lift vessel (e.g. the Can-Do Barge or a self-propelled Roll-Dock Vessel). In *Ops-1*, also known as the full-floating mode, the docking apparatus 100 operates neither with anchors/anchor chains, nor with the supporting legs 104 and associated spud can 300 anchored to the seabed to
15 maintain a relatively stationary position on water. Accordingly, FIGs. 13a to 13e illustrate operation of the docking apparatus 100 under *Ops-1*. It is to be appreciated that the abbreviation "*W.L*" (if indicated) in any of FIGs. 13 to 20 simply represents "water-level".

20 Specifically, in FIG. 13a the docking apparatus 100 is floating on water, configured in the lightship condition (e.g. for transit). Then upon arrival, as shown in FIG. 13b, the docking apparatus 100 is arranged to be semi-submerged, by operating the ballast and pontoon tanks 202, 600 (of the hull portions 106a, 106b, and platform 102) to accept ballast water up to a maximum
25 allowable draft, as designed for the docking apparatus 100. FIG. 13c depicts a floating vessel 1300 (or in other cases may be any transportable object) received into the docking apparatus 100, where the vessel 1300 is guided into the hull of the docking apparatus 100 by self-propulsion, or by tugs/dock winches. It is to be appreciated that a plurality of docking blocks 1302 may be
30 pre-positioned on the platform 102, so that the vessel 1300 (once received into the docking apparatus 100) may subsequently rest on the docking blocks 1302. So, at this juncture, there needs to be a minimum gap clearance between the hull of the vessel 1300 and the docking blocks 1302, so as to allow the vessel 1300 to be guided into the docking apparatus 100, without any hindrances from
35 the docking blocks 1302.

Once the vessel 1300 is received into the docking apparatus 100, the ballast and pontoon tanks 202, 600 are de-ballasted in a gradual controlled manner, so that the platform 102 (with the hull portions 106a, 106b) is slowly raised to a point of enabling the received vessel 1300 to now securely rest and sit on the docking blocks 1302, as shown in FIG. 13d. This step is considered a transient stage operation. It is to be noted that at this juncture, the docked vessel 1300 still partially floats on the water, and also rests on the docking blocks 1302. Then, in FIG. 13e, the ballast and pontoon tanks 202, 600 continue to be de-ballasted completely so that the platform 102 is raised to eventually enable the docked vessel 1300 to completely be lifted above the water-level, ready to be transported to wherever required.

Notwithstanding the above described, it is to be appreciated that under *Ops-1*, the supporting legs 104 may be soft-pinned to the seabed or pre-loaded, depending on a duration the docking apparatus 100 needs to be stationed onsite. Functioning in *Ops-1*, the docking apparatus 100 provides a complete solution onsite from loading to discharging marine assets, and carrying out sea-transportation (with sea-fastening), without need to construct piers and loadout quays at an intended locale of operation.

• **Operating Mode-2**

In an Operating Mode-2 ("*Ops-2*"), also known as the full-Jacked-up mode, the docking apparatus 100 is operated to a self-elevated or jacked-up state, where there are similarities to a jack-up barge, a self-elevated platform, or a lift boat. The docking apparatus 100 is self-elevated using her jacking system and also pre-loaded onsite. Accordingly, FIGs. 14a to 14f illustrate an installation phase of the docking apparatus 100 under *Ops-2*.

In FIG. 14a the docking apparatus 100 is floating on water, configured in the lightship condition (e.g. for transit). Upon arrival, the supporting legs 104 of the docking apparatus 100 are slowly lowered to the seabed (as shown in FIG. 14b) using the jacking system. That is, the supporting legs 104 are soft-pinned to the seabed. Next, using the jacking system, the hull of the docking apparatus 100 is elevated to be above the water-level, as depicted in FIG. 14c. Then, in FIG. 14d, water is pumped into the ballast and pontoon tanks 202, 600 (of the hull

portions 106a, 106b, and platform 102) to pre-load the supporting legs 104 and spud cans 300 for anchoring the docking apparatus 100 to the seabed. It is to be appreciated that further optional piling or other anchoring means may be added to more securely firm-up the anchored leg footing foundations, if
5 necessary. With that, FIG. 14e shows the completed installation of the docking apparatus 100 onsite, in which the ballast and pontoon tanks 202, 600 are already de-ballasted. To prepare for an operation phase under *Ops-2*, hatches arranged in the hull of the docking apparatus 100 may first be opened so that when said hull is subsequently lowered down to the water surface, water may
10 freely and slowly flow into the hull as part of the lowering step, thereby ensuring that no substantial buoyancy forces are generated to otherwise act against the hull to undesirably lift the already anchored supporting legs 104 and spud cans 300 out of the seabed. It is highlighted that the respective hatches are arranged to be in fluid communication with the ballast and pontoon tanks 202, 600.

15 FIGs. 15a to 15d illustrate an operation phase of the docking apparatus 100. Specifically, FIG. 15a continues from directly from the stage in FIG. 14f, where the hull of the docking apparatus 100 continues to be lowered below the water-level, and more water is introduced into the ballast and pontoon tanks 202, 600
20 via the opened hatches. It is to be appreciated that the hatches may remotely be operated to be closed so that the ballast and pontoon tanks 202, 600 can be de-ballasted, as necessary. So the docking apparatus 100 is now semi-submerged. Next, FIG. 15b, depicts a floating vessel 1500 (or in other cases may be any transportable/floatable asset) is received into the docking apparatus
25 100, where the vessel 1500 is guided into the hull of the docking apparatus 100 by self-propulsion, or by tugs/dock winches. Similarly, a plurality of docking blocks 1302 may be pre-positioned on the platform 102, for those reasons as explained under *Ops-1*.

30 Once the vessel 1500 has been received into the docking apparatus 100, the hatches are closed, and the ballast and pontoon tanks 202, 600 are controllably de-ballasted, so that the hull of the docking apparatus 100 is gradually raised to allow the received vessel 1500 to securely rest and sit on the docking blocks 1302, as shown in FIG. 15c. At this point, the docked vessel 1500 partially
35 floats on the water, while supported by the docking blocks 1302. Accordingly,

de-ballasting of the ballast and pontoon tanks 202, 600 continues to performed until said tanks 202, 600 are completed emptied, and concurrently or thereafter the jacking system is operated to lift the hull of the docking apparatus 100 and the docked vessel 1500 out of water as shown in FIG. 15d, i.e. above the water-level.

- **Operating Mode-3**

In an Operating Mode-3 ("*Ops-3*"), which is also known as the Hybrid Mode, the docking apparatus is effectively operated in a mode that marries the afore described *Ops-1* and *Ops-2*. Alternatively, the docking apparatus 100 may also be operated as not fully floating and not fully jacked-up. FIGs. 16 and 17 then illustrate how the docking apparatus 100 is operated in respective first and second modes of *Ops-3*.

FIG. 16 depicts a vessel 1600 (or in other cases may be any transportable object) that has already been received into the hull of the docking apparatus 100, which is in a semi-submerged state. If the vessel 1600 is to be lifted above the water-level, then the ballast and pontoon tanks 202, 600 are to be fully de-ballasted, and the operation phase under *Ops-2* is executed. For the first mode shown in FIG. 16, the jacking system is locked. It is to be appreciated that the maximum lift capacity of the docking apparatus 100 is approximately equal to the combination of lifting capacity afforded by the jacking system and buoyancy of the hull of the docking apparatus 100. Buoyancy forces experienced by the hull of the docking apparatus 100 are reduced when the hull of elevated above the water-level, as will be appreciated by skilled persons. Of course, if a marine asset to be docked at the docking apparatus 100 has an effective weight more than the configured lifting capacity of the jacking system, then a maximum level the docking apparatus 100 may lift the marine asset (using the maximum lift capacity) is only up to about the water-level during high tide, until the docked marine asset is just clear from the water-level.

For the second mode shown in FIG. 17, the jacking system is unlocked, so that a docked vessel 1700 may be lifted above the water-level. It is to be appreciated that a maximum jacked-up level the hull of the docking apparatus 100 may reach above the water-level is limited by the configured lifting capacity of the jacking

system. Also, a maximum lift force generated from buoyancy of the hull of the docking apparatus 100 occurs at high tides. Yet further, a design of the hull of the docking apparatus 100 is purposefully configured to gain more buoyancy at the lowest draft, and all the supporting legs 104 are arranged to be free-wheeling.

So, the Hybrid mode combines the lifting capacity of the jacking system, and buoyancy of the hull of the docking apparatus 100 (which is enhanced due to the “extended” hull shape providing more buoyancy at a lower draft) in conjunction with appropriately adjusting an amount of ballast water in the ballast and pontoon tanks 202, 600 (e.g. pumping-out more water to have increased buoyancy, and vice-versa) to assist in the jacking-up. The docking apparatus 100 is then jacked-up above the water-level to stabilise operations.

It is to be appreciated that prior to jacking-up the hull of the docking apparatus 100, and if lifting cranes are arranged on board, payload (e.g. raw-materials, loose machineries and etc.) placed on the deck of the platform 102 may optionally be moved to another floating barge using the lifting cranes, so to lighten a weight of the hull of the docking apparatus 100 to enable the jacking-up to a maximum level possible. Also, if this operation is carried out during high tide to extract maximum lift capacity provided from the resulting generated buoyancy and the lifting capacity of the jacking system, it then allows the docking apparatus 100 to more easily be able to lift a docked marine asset above the water-level to reduce likelihood of green water loading.

The supporting legs 104 of the docking apparatus 100 are further designed to optionally allow temporary strain jacks or hydraulic jacks to also be installable enhance the associated lifting capability. The installation of detachable “bulwark” after jacking-up the hull of the docking apparatus 100 to a highest level is also possible to avoid water ingress (green water loading). Ideally the capacity of the docking apparatus 100 will at least be matched to the displacement of a marine asset to be docked so that the buoyancy provided by the docking apparatus 100 is sufficient to raise the main deck area of the platform 102 high enough to be cleared from the water-level with sufficient freeboard.

If the lifting capacity is not an issue, then the buoyancy forces provided by the hull of the docking apparatus 100 is normally sufficient to lift up a docked marine asset. Similar to a floating dock, in the first mode of *Ops-3*, the jacking system of the docking apparatus 100 is freed, in which the supporting legs 104 serve as
5 “anchoring points” to the seabed. This enables the docking apparatus 100 to function as a truly “mobile shipyard”, where the docking apparatus 100 requires minimum onshore facilities (e.g. a mooring system for a floating dock, or workshops for each discipline of IMR work to be undertaken), as all the facilities are already provided within the docking apparatus 100. In this respect, a
10 minimum amount of time is required to setup a shipyard to meet local regulatory requirements, and so the docking apparatus 100 can easily be utilised as a “mobile shipyard”, beneficially without the associated issues.

FIGs. 18a to 18d illustrates yet another variant installation and operations phase
15 of the docking apparatus 100 (as contrasted with FIGs. 14a to 14f), when operated in the Hybrid mode. But in this instance, the docking apparatus 100 is not configured with the jacking system, but rather with high buoyancy lift capacity. In FIG. 18a, when the docking apparatus 100 is afloat at the designated locale, the supporting legs 104 are controllably lowered down to the
20 seabed by beneficially making use of the weight of the supporting legs 104 to do so, facilitated by gravity-assist. The supporting legs 104 may be movably held by respective lift cranes arranged at the top deck of the docking apparatus 100 to assist with the controlled lowering. Once the supporting legs 104 are soft-
25 pinned to the seabed, during the high tide, respective locking devices 1800 are activated to securely lock the supporting legs 104 in that position to prepare for the next step. Thereafter, in FIG. 18b, the hull of the docking apparatus 100 is ballasted in a controlled and monitored manner, so that the increased effective weight of the docking apparatus 100 now acts on the supporting legs 104 to
30 push the supporting legs 104 (under the effect of gravity, as the tide becomes lower) further into the seabed to more securely anchor the docking apparatus 100 thereto.

Once completed, in FIG. 18c, the locking devices 1800 are deactivated to release the supporting legs 104 from the locked position during the high tide,
35 and the hull of the docking apparatus 100 is de-ballasted so that the hull again

now floats under its own buoyancy. It is to be appreciated that the unlocking of the supporting legs 104 is a delicate operation, which may (for example) be performed using hydraulic control systems with heave compensators. Subsequently, the steps described in FIGs. 18b and 18c may be repeated (in
5 sequence) for a few times as deemed necessary, until the supporting legs 104 are determined to sit firmly and evenly on the seabed. Other optional station keeping devices 1802 (e.g. catenary mooring lines formed of cables, wires, or chains, suction anchors, piling and etc.) may also be employed to further secure the docking apparatus 100 in a final position, as shown in FIG. 18d. The station
10 keeping devices 1802 may also include a plurality of thrusters arranged with or without dynamic positioning capabilities.

To reiterate, the docking apparatus 100 may be used as a mobile shipyard, as previously mentioned. As a brief background for motivation to such usage, many
15 regions and countries are increasingly encouraging more oil, gas and marine projects and its related activities to be carried out within their own country boundaries, due to local content compliance and obligation issues. But this is often costly and time consuming for countries (e.g. African countries) which may lack the necessary infrastructure to do so. Furthermore, it is a challenging issue
20 for attracting capital investment to setup construction facilities that may potentially be only a one-off project, with no certainty of future demand, and not to also mention that it is doubtful there is any competitive edge to those setup facilities that can help to secure future international contracts.

25 So advantageously, this is where the docking apparatus 100 may come in useful. Specifically, the docking apparatus 100, which comes complete with high lifting capacity, docking facilities, carnage, workshops, control rooms, meeting facilities, offices, may quickly be deployed as a mobile shipyard to a required work location, since the docking apparatus 100 is highly mobile for deployment.
30 So functioning as a mobile shipyard as shown in FIGs. 20a and 20b, the docking apparatus 100 only needs minimum land facilities (with road access), thereby allow a contractor to enjoy huge costs advantages over his competitors to fulfil the local content requirements.

Moreover, since the “investment” (i.e. the docking apparatus 100) is actually a mobile asset, it is thus easier to re-deploy the docking apparatus 100 to other countries for similar-natured projects, if needed. This situation may unusually arise in African countries because shipyards in local neighbouring countries (e.g. between Nigeria & Angola) are not recognised as “local” in definition. The docking apparatus 100 is also easier to finance, via the “ship financing” model, where the country risk maybe high if there are onshore fixed facilities.

FIG. 19 includes FIGs. 19a to 19c, which depict transfer of docking objects/modules and the advantage of docking apparatus 100 when operated in the hybrid mode of *Ops-3*. Hence, the utilisation of the docking apparatus 100 as per in FIG. 19c is compared against a conventional floating dock 1900 and a roll dock 1950 (respectively depicted in FIGs. 19a and 19b). FIG. 19a shows the floating dock 1900 with a lowered ramp 1902 leading to shore, and in particular a position of the floating dock 1900 is heavily influenced by tidal changes 1904, which means that the ramp 1902 undesirably displaces in position, laterally and vertically, during the tidal changes 1904. Then, the roll dock 1950 is depicted in FIG. 19b, where a transportable object/module 1952 is used for load-in and load-out operations (to be transferred from onshore and vice-versa) between the roll dock 1950 and onshore. Similarly, the roll dock 1950 is affected by the tidal changes 1904, which means that there is actually a short time window to quickly carry out the load-in and load-out operations. Further, a steel pier (not shown) may also be needed to hold the roll dock 1950 for the scenario shown in FIG. 19b.

In FIG. 19c, it is also to be appreciated that the transportable object/module 1952, being transferred to the docking apparatus 100, may instead also be, but not limited to, any one of the following modules:

- Ships, vessels, or floating offshore units;
- Offshore production or maintenance units, including oil & gas facilities, accommodations, services and maintenance facilities;
- Drilling packages, includes derricks and related drilling equipment, which may be a “land-rig” package or an offshore drilling package.

- Work support units, including cranes, subsea or diving supports, windmill installation packages, pipe or cable laying equipment, workshops, and etc.;
- Construction or maintenance material or consumables, such as drill pipes, pipeline, windmill components, drilling muds or other substances, chemicals for production or treatments, injection pumps, compressors units, and etc.

Further, the transportable object/module 1952 and docking apparatus 100 may be operated together for one or more of the following applications, but not limited to:

- Jack-up or floating drilling rig, or hybrid;
- Jack-up or floating support vessel, or hybrid;
- Jack-up or floating work-boat, or hybrid;
- Jack-up or floating processing units, or hybrid;
- Jack-up or floating compression or pumping units, or hybrid;
- Jack-up or floating substation/transmitter station, or hybrid;
- Jack-up or floating accommodation, or hybrid;
- Jack-up or floating maintenance support vessel, or hybrid;
- Jack-up or floating mobile shipyard, or hybrid; and
- Jack-up or floating docking facility, or hybrid.

On the other hand, the docking apparatus 100 may be used as a ramp quayside with minimum investment on mooring or heavy sheet-piled quayside, which is advantageous over the floating dock 1900/roll dock 1950, whose operations are affected by the tidal changes 1904. So, the floating dock 1900 / roll dock 1950 need to continuously be adapted to the tidal changes 1904 by adjusting associated buoyancy (of the floating dock 1900/roll dock 1950) using an active ballast system, which is similar to heavy-lift vessels or barges.

For the docking apparatus 100, associated gears of the jacking system can be locked to significantly restrict movement of the hull of the docking apparatus 100 (via the lowered supporting legs 104) in all six-degrees of freedom, so that a ramp 1980 deployed from the docking apparatus 100 to the shore is maintained at a substantially fixed inclination, regardless of the tidal changes 1904. This is

extremely important for delicate operations, i.e. to move a docked object from the docking apparatus 100 to onshore, and/or to move a constructed module/object from onshore to the docking apparatus 100. For such heavy loading operations, the deployed ramp 1980 is to be nearly flat and in a horizontal elevation, during the delicate "load-out" or "load-in" operations. If necessary, a longer ramp is used as the deployed ramp 1980, instead of needing a piled jetty or loading quay. In contrast, the floating dock 1900/roll dock 1950 tends to floats up and down during the loading operations, which may unwittingly cause damages to the transportable object/module 1952 to be transferred. Moreover, unpredictable sudden changes in weather/sea conditions may also potentially complicate the loading operations, and if not careful, catastrophic consequences may even happen.

The docking apparatus 100 is also operable to function similarly as a Ship-lift when being operated in the *Ops-3* mode. In this arrangement, the docking apparatus 100 acts like a Ship-lift to dock and transport ships/floating structures onshore for servicing, and may beneficially provide multiple "berth spaces" for ships to be docked. So, the docking apparatus 100, similar to the Ship-lift, is used as the main docking/un-docking device to serve a large number of onshore construction facilities.

Accordingly, the docking apparatus 100 is thus ideal for deployment in new start-up shipyard facilities, as an alternative to costly traditional fixed dry-dock facilities.

So in summary, the docking apparatus 100 is able to function like a ship-lift without need for marine civil construction of pier(s), depending on requirements for the ship-lifting. The docking apparatus 100 is capable of self-installation and hence can be speedily mobilised and installed onsite. The docking apparatus 100 is highly flexible and can be adaptively switched from operating in *Ops-1* to *Ops-3* giving further advantage over the ship-lift.

Yet further, as depicted in FIG. 20a, the docking apparatus 100 may function as a floating (or fixed) jetty, by operating in the Hybrid mode with the jacking system not utilised (i.e. unlocked) or without the jacking system. In particular,

the docking apparatus 100 is deployed for conventional berthing operations, on the port and starboard sides of the hull, when the docking apparatus 100 is used as a jetty or as a "finger pier" for berthing. Usually in such circumstances, the hull of the docking apparatus 100 is arranged to be floating, while the supporting
5 legs 104 and footings are lowered to the seabed to act as "sleeved piles". So the hull of the docking apparatus 100 is allowed to heave freely with the tides, but the supporting legs 104 are constrained in the seabed as "sleeves", restricting most of other five degrees of movements of the docking apparatus 100 in the water. Therefore, the docking apparatus 100 is operable for use as a
10 floating jetty, in benign to intermediate weather conditions.

As explained previously, the docking apparatus 100 can be used as a mobile shipyard (i.e. see FIG. 20b), which is the fastest way to setup a green field shipyard with minimum adequate onshore facilities. That is, the docking
15 apparatus 100 enables a shipyard with docking facilities and piers to be quickly set up and ready for shipyard operations. So, the docking apparatus 100 may act as a truly and fully functional mobile shipyard.

In summary, the docking apparatus 100 is capable of lifting any type of maritime
20 assets (e.g. ships, floating assets, structures and/or offshore and onshore units), and more particularly, is designed to dock and lift a maritime asset out of water using the ballast and pontoon tanks 202, 600 and/or to further elevate the docked maritime asset above the water surface using the jacking system with the supporting legs 104 configured with spud cans 300. As will be appreciated
25 by now, the docking apparatus 100 includes the hull portions 106a, 106b arranged on the starboard and port sides of the platform 102, and with the pontoon tanks 600 and moon-pools 110 with removal hatch covers arranged in the hull portions 102a, 102b, in which the interior of the docking apparatus 100 may be adapted for different purposes in varying industries. As outlined above,
30 each hull portion 106a, 106b is dividable into the different compartments for specific purposes. For example, certain compartments may be arranged to hold the ballast tanks 202, while other compartments may be configured into machinery rooms, HPU rooms, HVAC handling units, stores, workshops, living quarters, jacking houses 108, leg-housings (for accommodating the supporting
35 legs 104), control stations and etc, depending on intended applications.

For completeness, the docking apparatus 100 is industrially classified based on various criteria including a total projected payload (to be lifted) as its lifting capacity, a number of supporting legs 104 installed, the range of water depth for which the docking apparatus 100 is operable in, and intended applications for use. The docking apparatus 100 is deployable to anywhere (i.e. offshore/near onshore) in both sea and river localities, except where limited by the water depth. It is to be appreciated the docking apparatus 100 may be anchored at the supporting legs 104 and spud cans 300 to the seabed hence securing the docking apparatus 100 to a land quay and is connected to the land quay when the forward ram door 109 is opened, and/or an offshore land with quay for connecting the docking apparatus 100 to the land.

Compared to conventional docking solutions, the docking apparatus 100 is distinctively different, and has a number of advantages (e.g. able to include various add-on components, and ease of operation), which include:

1. Provides a mobile "shipyard docking system" stationed nearer to vessels to be repaired, and thus enables repair/maintenance services to be provided at worksites of the vessels without requiring the vessels to sail to shipyards instead for repairs, which may incur longer loss-time for critical operations. For example, for a large oil field development, an offshore construction vessel (OCV) may be docked with the docking apparatus 100 (positioned onsite) for local routine/emergency repairs with reduced down time and costs for charter parties/owner of the OCV.
2. Allows required services to be provided on site, in the field development anchorage at countries external to national shoreline in the form of Off Port Limits (OPL) anchorage. Also, services may be provided at an offshore site for maritime, marine civil, harbour, defence, mining activities and the like, which may beneficially be carried out in sheltered shallow water areas for marine, oil, gas, and renewable energy industries. The docking apparatus 100 may operate in localities with shallow and benign waters. So given the versatility of the docking apparatus 100, it is able to serve the varying needs of different applications of the aforementioned industries. So using the docking apparatus 100 may provide cost savings for IMR and other

emergency/salvage operations, and not to mention, when the docking apparatus 100 is used as an accommodation facility, crew members are provided with a comfortable working environment onboard the docking apparatus 100, since there is improved station keeping and reduced exposure to rough sea conditions. Also, side-to-side rocking and swerving motions typically experienced on-board marine vessels due to wave movements are however significantly reduced on the docking apparatus 100 as the docking apparatus 100 may beneficially be elevated above the sea level, if necessary to avoid such situations.

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3. Eliminates usage of costly Dynamic Positioning (e.g. a DP-2 system) station keeping systems, since the docking apparatus 100 is conveniently deployable to any location worldwide, as it is able to function also as an accommodation platform to support offshore operations. As indicated in point (2), the crew members of the docking apparatus 100 are able to enjoy a comfortable working environment for this purpose, and the docking apparatus 100 is flexibly reconfigurable to provide living quarters/work spaces/recreational spaces for the crew members.

15

20 4. Incurs a significantly lower capital expenditure (CAPEX) investment costs compared to conventional docking solutions.

5. Operable as an "independent shipyard", where offices, meeting rooms, accommodations and workshop spaces may be provided in the docking apparatus 100. In particular, the docking apparatus 100 is beneficially designed to be a "self-sufficient" and mobile shipyard, in which the hull portions 106a, 106b and platform 102 are able to house a variety of working spaces, as outlined afore.

25

30 6. Enables any floating vessels to undergo repairs/vessel conversion/quick upgrade locally onsite. As discussed above, the docking apparatus 100 may be mobilised at a short notice, say (for example) for emergency situations, prospective distress and salvage operations, and etc. The docking apparatus 100 may also be deployed for quick retrofitting/upgrading of

military vessels for rapid mobilisations as the docking apparatus 100 has self-installation capability.

- 5 7. Provides a cost effective solution by significantly reducing down-time for repairing vessels by performing the repairs onsite, and further, there is no need to prepare stand-by vessels, for the vessels being repaired, for work operations that are of high value and fast-track in nature.
- 10 8. Provides an improved technological solution for ship recycling industries, which are not met conventionally. The docking apparatus 100 provides waste recycling functionalities which are deployed during demolition of the scrapped vessel handling (performed during ship breaking) and allow any oily and unwanted waste materials collected to easily be transferred from the docking apparatus 100 to onshore processing facilities, without posing any
15 hazards. It is to be appreciated that the vessel to be demolished can be transferred to shore using air-bag system/technology, currently available after the vessel and oily material are removed from said vessel. Prior to transferring the vessel onshore, the entire external hulls of the vessel can be scraped and washed using ultra-high pressure (UHP) waterjets and the
20 resulting contaminants (generated from washing the hulls) are treated before being discharged. Hence, the docking apparatus 100 may serve as a green ship recycling asset for multiple ships for demolition on dry land.
- 25 9. May be operated in conjunction with, and complements conventional offshore lift-boats and self-elevated platforms for transportation, installation and repair operations in the offshore wind power generation market.

Hence, the docking apparatus 100 is purposefully arranged to achieve the following.

30

Firstly, under *Ops-1*, the docking apparatus 100 is configured to work like a floating dock or a semi-submersible barge - all underwater moving/sliding parts/hinges (e.g. covers for the moon-pools 110) of the docking apparatus 100 are carefully devised to take into consideration how a vessel will be received and
35 docked with the docking apparatus 100. In this way, vessels with protruding

thrusters, or any other appendages under the hull of the vessels or transportable objects, can be easily docked at the docking apparatus 100, and is known as the full floating mode of the docking apparatus 100 – in this floating mode, the docking apparatus 100 can be towed with the docked object from one point to another. Therefore the docking apparatus 100 is usable for transporting vessels in this floating mode (with the supporting legs 104 in the retracted position), and be moved by tugs assistance or at lower speed using its own propulsion system as installed. The docking apparatus 100 is highly versatile in that different reconfigurations and add-on equipment may easily be adopted (e.g. installable with the water propulsion devices for self-propelling ability so that assisting tugs to move the apparatus 100 may not be required for an area of operations. Moreover, the docking apparatus 100 is operable to sail-away during mobilization and de-mobilization phases in this floating mode or can be stationed as a floating dock.

Secondly, as explain in the section: “*Functional Modes of Operations*” above, in the elevated position the docking apparatus 100 is deployable for a wide range of applications which includes: providing casualty evacuation, providing accommodation quarters for crew members, providing a base for installation of communication satellites, provide repairs for oil rigs, subsea equipment, and blow-out preventer (BOP) offshore equipment, serving as a warehouse for logistic/offshore workshops, providing a helipad for transfer of personnel/cargo to/from an offshore location. Finally, the docking apparatus 100 is operable under low investment costs, compared to conventional solutions.

So, it may be seen that the docking apparatus 100 is able to provide the same functionalities as a ship-lift, but without need for conventional marine pier(s), depending on the arrangement of the ship-lift. The docking apparatus 100 can also be quickly mobilised and deployed for use. Hence, usage of the docking apparatus 100 incurs less investment costs than traditional fixed base docking structures yet boasts greater flexibility. In applications pertaining to shallow water oil and gas exploration/early production development, the docking apparatus 100 may flexibly function as a “Jack-up Drilling Rig” and a “Mobile Offshore Production Unit (MOPU)” for those purposes.

While the invention has been illustrated and described in detail in the drawings and foregoing description, such illustration and description are to be considered illustrative or exemplary, and not restrictive; the invention is not limited to the disclosed embodiments. For example, the docking apparatus 100 is optionally
5 configurable with necessary equipment to mitigate any wave-induced motions experienced by the docking apparatus 100. Also, the hull portions 106a, 106b may be integrally formed with the platform 102.

Claims

1. A mobile docking apparatus comprising:
 - a platform having a plurality of platform sections forming a deck which is arranged to receive at least one floating/transportable object;
 - a collection-well arranged in the platform; and
 - a plurality of supporting legs movably coupled to the platform and configurable to be lowered to the seabed to anchor and/or support the apparatus,wherein the platform is operable cooperatively with the lowered supporting legs to be adaptively raised or lowered with reference to a water-level to receive and lift the object, and
wherein the platform sections forming the deck are cooperatively arranged at respective angles to the longitudinal axis of the platform to enable fluid waste materials to be drained towards the collection-well.
2. The apparatus of claim 1, further comprising:
 - a pair of hull portions respectively arranged at the port and starboard side of the platform; and
 - a plurality of ballast tanks arranged in the platform and the hull portions, which are operable for adjusting a buoyancy of the apparatus to enable the platform to be adaptively raised or lowered.
3. The apparatus of claim 2, wherein the hull portions are formed integral with the platform.
4. The apparatus of claim 2, further comprising:
 - a plurality of trapezium-shaped like sections,
 - wherein each hull portion includes a side coupled to the platform and an opposite side from which one of the trapezium-shaped like sections is extended, and
 - wherein some of the ballast tanks are arranged in the trapezium-shaped like sections to enhance buoyancy of the hull portions.
5. The apparatus of any preceding claims, wherein the supporting legs include being arranged at the hull portions.
6. The apparatus of claim 5, wherein the supporting legs include at least two pairs of supporting legs respectively arranged at each hull portion.

7. The apparatus of any preceding claims, wherein at least one of the hull portions is configurable with at least one lifting crane.
8. The apparatus of claim 7, further including a set of guiding tracks arranged at the hull portions, wherein the at least one lifting crane is operable to be movable along the guiding tracks.
9. The apparatus of any preceding claims, further comprises at least one extension platform having a collapsible arrangement.
10. The apparatus of any preceding claims, further comprises a plurality of sensors configured to monitor for structural integrity of the apparatus.
11. The apparatus of claim 2, wherein the object is a vessel, and wherein each hull portion is configured with a ramp door to facilitate loading and/or unloading of cargo from the docked vessel.
12. The apparatus of claim 2, further comprising at least one passageway arranged within the platform to enable access between the pair of hull portions.
13. The apparatus of any preceding claims, wherein the supporting legs include respective spud cans movably arranged to substantially stabilize the anchored apparatus against the seabed, when the supporting legs are lowered.
14. The apparatus of any preceding claims, wherein each supporting leg includes at least a first drive unit hydraulically operable to raise or lower the platform, and the first drive unit is part of a hydraulic ring beam lifting system.
15. The apparatus of any preceding claims, wherein each supporting leg includes at least a second drive unit electrically operable to raise or lower the corresponding supporting leg, and the second drive unit is part of a rack and pinion gear-lifting system.
16. The apparatus of claim 15, wherein the second drive unit is configured to be operated based on a rack-and-pinion arrangement, and an associated driving gear.

17. The apparatus of any preceding claims, further comprises at least one water propulsion device to propel the apparatus.

18. The apparatus of any preceding claims, wherein the supporting legs are configurable includes being arranged to be ballastible to enable the supporting legs to be lowered to the seabed.

19. The apparatus of any preceding claims, further comprising respective locking devices configured to releasably lock the respective supporting legs in position, relative to the platform.

20. The apparatus of any preceding claims, further comprising a plurality of station keeping devices used in conjunction with the lowered supporting legs to securely anchor the apparatus to the seabed.

21. The apparatus of claim 20, wherein the station keeping devices include a spread mooring system.

22. The apparatus of claim 20, wherein the station keeping devices include a plurality of thrusters arranged with or without dynamic positioning configuration.

23. A method of operating a mobile docking apparatus, which includes a platform having a plurality of platform sections forming a deck which is arranged to receive at least one floating/transportable object, and a plurality of supporting legs movably coupled to the platform, the method comprises:

configuring the supporting legs to be lowered to the seabed to anchor and/or support the apparatus;

operating the platform cooperatively with the lowered supporting legs to adaptively raise or lower the platform with reference to a water-level to receive and lift the object; and

draining, by assistance of gravity, fluid waste materials from the platform sections forming the deck towards a collection-well arranged in the platform, wherein the platform sections forming the deck are cooperatively arranged at respective angles to the longitudinal axis of the platform.

24. The method of claim 23, wherein operating the platform cooperatively with the lowered supporting legs includes:

controllably de-ballasting or ballasting a plurality of ballast tanks arranged in the platform, a pair of hull portions and a plurality of trapezium-shaped like sections, wherein the hull portions are respectively arranged at the port and starboard side of the platform, wherein each hull portion includes a side coupled to the platform and an opposite side from which one of the trapezium-shaped like sections is extended.

25. The apparatus of claim 1, the floating/transportable object can be transferred to the platform by the means of:

- Floated-in by tugs or other mechanical means
- Lifted-in by cranes or other mechanical means
- Or moved into position through front and side ramp from onshore or another platform, with bottom supported rollers, skidding beams, transporters, or similar means

In this case, any of the object may or may not floatable, which may include one or more of the following:

- Ships, vessels, or floating offshore units
- Offshore production or maintenance units, including oil & gas facilities, accommodations, services and maintenance facilities
- Drilling packages, includes derricks and related drilling equipment, in which can be a "land-rig" package or offshore drilling packages.
- Work support units, including cranes, subsea or diving supports, windmill installation packages, pipe or cable laying equipment, workshops, etc
- This may include construction or maintenance material or consumables, such as drill pipes, pipeline, windmill components, drilling muds or other substances, chemicals for production or treatments, injection pumps, compressors units, etc.

26. The apparatus of claim 25, wherein the object and apparatus may operate together for one or more of the following applications:

- Jack-up or floating drilling rig, or hybrid
- Jack-up or floating support vessel, or hybrid
- Jack-up or floating work-boat, or hybrid
- Jack-up or floating processing units, or hybrid
- Jack-up or floating compression or pumping units, or hybrid
- Jack-up or floating substation/transmitter station, or hybrid
- Jack-up or floating accommodation, or hybrid

- Jack-up or floating maintenance support vessel, or hybrid
- Jack-up or floating mobile shipyard, or hybrid
- Jack-up or floating docking facility, or hybrid.