

VESSELS

This invention relates to a method of constructing a multi-hull vessel and to such a vessel.

Multi-hull vessels are known in naval architecture. Many
5 are purpose-built vessels to be used, for example, as passenger and/or goods carriers or as sailing ships.

The two existing types of vessels that are in most common use for oil and/or gas exploration, and/or production, are semi-submersible vessels and mono-hull vessels. These
10 vessels are generally used where the water depth is too great, or the oil and/or gas field is too small, to justify the cost of a fixed drilling and/or production platform.

It is known to convert a mono-hull oil tanker, or other suitable mono-hull vessel, into a mono-hull vessel for use in
15 oil and/or gas drilling and/or production. The conversion is achieved by modifying the tanker mono-hull. These modifications are the formation of one or more generally vertical openings through the mono-hull vessel to incorporate some of the equipment required for oil and/or gas drilling and/or production. One of the openings is required for a moon
20 pool for one or more derricks and/or one of the openings is required for a turret moon pool, and one of the openings is required for each thruster, of which there are typically four per vessel. The mono-hull vessel deck, hold and hull are
25 adapted to incorporate the equipment required on-deck and in the hold. The conversion is completed by the installation of on-deck equipment and support structures, operating crew accommodation where required, a helideck (helicopter landing deck), the equipment in the hold, and the one or more
30 derricks and/or the turret and/or the flare. The piping required on-deck of a mono-hull tanker means that additional structures are required to support some of the on-deck drilling and/or production equipment, these structures being built over the tanker on-deck piping and supported on the
35 vessel deck. These structures can be heavy and costly and do

not significantly contribute to the overall strength of the vessel. The mono-hull vessel can be converted back to a mono-hull tanker by the reverse processes. The conversion processes can be lengthy and relatively expensive and the
5 mono-hull vessel has a number of weaknesses, including greater motion responses, to roll motions in particular, when compared with a multi-hull vessel or a semi-submersible vessel for a given sea state.

According to a first aspect of the present invention,
10 there is provided a method of constructing a multi-hull vessel comprising fixing a first unitary part of the vessel to a second unitary part of the vessel by way of a transition section structurally interconnecting structural elements of the first unitary part with structural elements of the second
15 unitary part.

According to a second aspect of the present invention, there is provided a multi-hull vessel comprising a first unitary part comprised of first structural elements, a second unitary part comprised of second structural elements, and a
20 transition section whereby said first structural elements are connected to said second structural elements.

A basic concept behind the present invention is the use of a transition section structurally to interconnect structural elements of one unitary part, normally pre-
25 existing and for example a mono-hull, with structural elements of another unitary part, again normally pre-existing and for example a generally horizontal continuous structure, in constructing a multi-hull vessel.

In this way, the construction of multi-hull vessels is
30 made more flexible, can be made more economical, can be simplified, and can be rendered more environmentally friendly by re-cycling of existing unitary parts. For example, one or more unitary parts can be built at one or more suitable locations, possibly have one or more transition sections
35 attached thereto at such location(s) and then assembled at

such location or a further location. Alternatively or additionally, one or more pre-existing unitary parts can have one or more transition sections attached thereto at one or more locations and then be assembled at such location or a further location. After the multi-hull vessel has been used for its intended purpose, it can be dismantled by disconnection at the transition sections and the transition sections possibly removed, leaving the unitary parts free to be used for other purposes, for example combined with other unitary parts, by way of the same transition sections or, if those have been removed, further specially designed transition sections, to form another multi-hull vessel.

In one general version of the present invention, a multi-hull vessel is constructed by fixing to the deck and/or port and starboard side shells of a mono-hull vessel which forms a central hull, by way of a central transition section, one generally horizontal continuous structure that is continuous between its port and starboard edges. Two outer hulls are provided, one at the laterally port outer region of the continuous structure, and the other at the laterally starboard outer region of the continuous structure.

In this general version, the laterally outer edge of the port outer mono-hull may be located at the port laterally outer region of the generally horizontal continuous structure, and the lateral outer edge of the starboard outer mono-hull may be located at the starboard laterally outer region of the generally horizontal continuous structure.

In a second general version of the present invention, a multi-hull vessel is constructed by fixing to port and starboard side shells and/or a deck of a mono-hull vessel which forms a central mono-hull, by way of two longitudinal transition sections, one port and one starboard, two generally horizontal projecting structures, one port and one starboard, and/or, by a central transition section, a generally horizontal central structure. Two outer mono-hulls

are also provided, one outer mono-hull being located at the laterally outer region of the port projecting structure, and the other outer mono-hull being located at the laterally outer region of the starboard projecting structure. The two longitudinal transition sections allow for any differences in the constructional details between the port and starboard projecting structures, and the existing or newly built port and starboard central mono-hull side shells and/or adjacent deck.

In this general version, the laterally outer edge of the port outer mono-hull may be located at the laterally outer region of the port projecting structure, and the laterally outer edge of the starboard outer mono-hull may be located at the laterally outer region of the starboard projecting structure.

Alternatively, in either of those two general versions, the outer edges of the outer mono-hulls may be located laterally inboard from the outer edges of the structure(s).

In both general versions, each of the port and starboard outer mono-hulls may be integral with the structure(s), or, alternatively, be connected to the structure(s) via port and starboard outer transition sections.

Each of the longitudinal transition sections, central transition section and outer transition sections may comprise a plurality of transition sub-sections which may, if required, be connected to each other within the section, by any suitable means, to form a monolithic longitudinal transition section.

Also, in both versions, the overall longitudinal dimension measured between the forward and aft extremities of each of the port and starboard outer mono-hulls may be similar to, or less than, or greater than, the overall length measured between the forward and aft extremities of the central mono-hull. The longitudinal locations of the forward and/or aft extremities of the port and starboard outer mono-

hulls may be within, or beyond, the forward and/or aft extremities of the central mono-hull.

Equipment may be located on, or within, the outer mono-hulls and/or the structures and/or the transition sections and openings to suit the equipment may be formed in the outer mono-hulls and/or the structures and/or the transition sections.

Each of the port and starboard outer mono-hulls may comprise a plurality of sub-hulls preferably aligned fore-and-aft, in which case the sub-hulls within each mono-hull may, if required, be connected to each other by any suitable means, to form monolithic port and starboard outer mono-hulls.

Each of the generally horizontal projecting structures, central structure and continuous structure may comprise separate sub-structures which may, if required, be connected to each other within the structure, by any suitable means, to form a monolithic structure.

When port and starboard generally horizontal projecting structures are provided, the overall longitudinal dimension measured between the forward and aft extremities of each of the port and starboard generally horizontal projecting structures may be similar to, or less than, or greater than, the overall length measured between the forward and aft extremities of the central mono-hull, and/or the port and starboard outer mono-hulls. The longitudinal location of the forward and/or aft extremities of the port and starboard generally horizontal projecting structures may typically be within, or beyond, the forward and/or aft extremities of the central mono-hull, and/or the port and starboard outer mono-hulls.

When a generally horizontal central structure is provided it may be located on a central mono-hull deck via a central transition section and may be between port and starboard longitudinal transition sections. The central

structure may be have levels that are similar to, or different from, the levels of the adjacent port and starboard longitudinal transition sections. The central structure may be attached to the longitudinal transition sections. The longitudinal location of the forward and/or aft extremities of the central generally horizontal structure may typically be within, or beyond, the forward and/or aft extremities of the central mono-hull, and/or port and starboard outer mono-hulls.

When a generally horizontal continuous structure is provided, the overall longitudinal dimension measured between the forward and aft extremities of the generally horizontal continuous structure may be similar to, or less than, or greater than, the overall length measured between the forward and aft extremities of the central mono-hull, and/or the port and starboard outer mono-hulls. The longitudinal locations of the forward and/or aft extremities of the generally horizontal continuous structure may be within, or beyond, the forward and/or aft extremities of the central mono-hull, and/or the port and starboard outer mono-hulls.

When a central transition section is provided, it is located under the generally horizontal central structure, or the generally horizontal continuous structure, as the case may be, and attached to the mono-hull vessel central mono-hull deck and/or port and/or starboard side shells, and/or, if provided, port and starboard longitudinal transition sections. The overall longitudinal dimension measured between the forward and aft extremities of the central transition section may be similar to, or less than, or greater than, the overall length of the superimposed structure and/or the port and starboard longitudinal transition sections.

The central mono-hull, if provided, may be purpose-built or an existing vessel. Where an existing mono-hull vessel is used, additional local strengthening and/or modifications to the deck and/or side shells and/or internal structure(s) may

be required where the transition sections connect to the side shells and/or the deck.

One or more decks may be provided on the multi-hull vessel at any vertical location(s) on or within any of the structures and/or transition sections. The depth between two or more decks can, if required, be sufficient to provide one or more enclosures between the decks and/or structures and/or transition sections. These enclosures, which may be weather-resistant, will allow for the incorporation of any cargo space, and/or additional floors, and/or equipment, and/or tanks, and/or control rooms, and/or accommodation required on the multi-hull vessel.

The level of such deck may differ along its overall length and width, and/or between adjacent structures, within structures, between transition sections and/or within transition sections.

One or more equipment and/or operations openings may be provided in the multi-hull vessel. In particular, in certain multi-hull vessel applications, some equipment, and/or operations on the vessel, may require one or more generally vertical openings to be formed through any of the structures, and/or transition sections, and/or decks. The openings allow equipment to extend, and/or operations to be carried out, below the lowest levels of the structures, and/or the lowest deck level, to or below the sea/water level. The openings may be located at any position on plan that is not occupied by the central mono-hull.

Removable and/or retractable screens may be provided to any of these openings to protect, from current and/or wave action and/or vessel motion, any equipment that projects below, and/or operations carried out below, the openings. When the multi-hull vessel is in transit, and/or the equipment is not in use, the equipment may be removed, or withdrawn to or above the lowest level of the openings, and the screens may be removed and/or retracted to reduce the

drag, due to current and/or wave action and/or vessel motion on the multi-hull vessel. The screens may be of any shape and size to suit the equipment and/or openings, and each screen may be comprised of one or more elements.

5 A new multi-hull vessel may be built by removing from the existing multi-hull vessel, and re-using on the new vessel, any or all of the unitary parts. The port and starboard outer mono-hulls, when they are connected to the port and starboard projecting structures, or the continuous
10 structure, by outer mono-hull transition sections, may be removed from the structure(s) on the existing multi-hull vessel, and be re-used, in conjunction with new or existing modified port and starboard outer mono-hull transition sections, in a new multi-hull vessel.

15 The port and starboard projecting structures and the port and starboard outer mono-hulls when they are integral with the projecting structures, may be removed from the existing multi-hull vessel, and be re-used, in conjunction with new or existing modified port and starboard longitudinal
20 transition sections, in a new multi-hull vessel.

 The generally horizontal central structure, when provided, may be removed from the existing multi-hull vessel and be re-used, in conjunction with a new or existing modified central transition section, in a new multi-hull
25 vessel.

 The generally horizontal continuous structure, when the port and starboard outer mono-hulls are connected to that continuous structure by outer mono-hull transition sections, may be removed from the existing multi-hull vessel and be re-
30 used, in conjunction with new port and starboard outer mono-hull transition sections, if required, in a new multi-hull vessel.

 When the generally horizontal continuous structure and the port and starboard outer mono-hulls are integral, the
35 continuous structure and the outer mono-hulls may be removed

from the existing multi-hull vessel and be re-used, in conjunction with a new or existing modified central transition section, in a new multi-hull vessel.

5 The central mono-hull may be removed from an existing multi-hull vessel and be re-used in a new multi-hull vessel.

It is possible to construct a multi-hull vessel using an existing mono-hull vessel, or a newly built mono-hull, to form the central mono-hull simply and efficiently.

10 The conversion of a mono-hull vessel into a multi-hull vessel for any, or more than one, specific use, e.g. oil and/or gas drilling and/or production, can be quicker and cheaper than the presently known conversion of an existing or newly built mono-hull vessel into a mono-hull vessel for such use(s), particularly because far less hull modification is
15 needed. Similarly, conversion of the multi-hull vessel central mono-hull back to a mono-hull vessel can be quicker and cheaper.

Any cargo space, and/or additional floors, and/or equipment, and/or tanks, and/or control rooms, and/or
20 accommodation, that would be located on the deck of the mono-hull vessel, can be located instead on, or within, the port and starboard projecting structures, and/or the central structure, and/or the continuous structure. Any of the equipment which would be located in the hull, and/or
25 generally vertical openings in the hull, within the suitably modified hull of the mono-hull vessel, can be located instead on, or within, the port and starboard projecting structures, and/or the central structure, and/or the continuous structure.

30 The resulting vessel, e.g. to be used for oil and/or gas exploration and/or production at sea and in inland waterways, by being multi-hull, is an improvement over the known vessels.

A much greater roll and pitch stability can be achieved
35 with a multi-hull vessel than with a mono-hull vessel. A

multi-hull vessel, e.g. an oil and/or gas drilling and/or production vessel, when compared with a mono-hull vessel with similar equipment and use, will have reduced roll and/or pitch motions for a given sea state. A multi-hull vessel, when compared with a mono-hull vessel with similar equipment and use, can for similar maximum roll and/or pitch motions for the mono-hull vessel operate in more severe sea states, permitting an increase of the time spent operating and thereby reducing operating costs and improving operating efficiency.

Moreover, for a given application, e.g. for oil and/or gas drilling and/or production, if a multi-hull vessel is used, then a smaller existing, or newly built, central mono-hull can be used for the conversion, as the final multi-hull vessel will have the necessary space on, and within, the structures, and/or decks, to incorporate the required equipment.

When compared with a mono-hull vessel of a similar overall length, the relatively larger area and depth available on, and/or within, the structures, and/or the decks, and/or the outer mono-hulls, of the multi-hull vessel will allow the required equipment to be located on, and/or within, the structures and/or the decks and/or the outer mono-hulls. This will reduce the number of, and/or size of, and/or need for topside structures, thereby reducing the cost of the vessel. The overall equipment vertical centre of gravity height is thus reduced, which further reduces the roll and pitch motions of the multi-hull vessel for a given sea state. The need to install equipment in the central mono-hull can be avoided.

Again, in an existing mono-hull vessel, in addition to accommodation for the ship's crew, typically located near the stern, there may be accommodation, typically located near the bow, provided for the operational crew who operate the specialist equipment on the mono-hull vessel. However with

the present multi-hull vessel, the safety of the operational crew can be increased, since all of their accommodation can, when required, be located in or on the structures in the vicinity of the ship's crew's accommodation at the stern; all of the crew accommodation being in one location will allow easier escape in the event of an emergency.

The equipment required for oil and/or gas drilling and/or production on a multi-hull vessel, would include one or more derricks and/or a turret. Generally vertical openings are formed through the structures, and/or decks, to incorporate the equipment. There would be one or more openings for one or more derricks, and one opening for the turret, which may be located at any convenient location plan that is not occupied by the central mono-hull and/or the port and starboard outer mono-hulls.

Equipment may be installed on, and/or within, the port and starboard outer mono-hulls, and openings to suit the equipment may also be formed in the outer mono-hulls. Generally vertical openings to incorporate the thrusters, which would typically be four per multi-hull vessel, are formed through each of the outer mono-hulls, two openings in the port outer mono-hull, and two openings in the starboard outer mono-hull. The need to install equipment in the central mono-hull, and the need to modify the vessel central mono-hull to suit the equipment are thus avoided.

In order that this invention may be clearly and completely disclosed, reference will now be made, by way of example, to the accompanying drawings, in which:-

Figures 1A to 1D respectively are a diagrammatic plan, diagrammatic alternate side elevations, and a diagrammatic end elevation showing in a general manner a multi-hull vessel;

Figure 1E is a diagrammatic perspective view showing in a general manner the process of construction of that multi-hull vessel;

Figures 2A to 2D respectively are views corresponding to Figures 1A to 1D showing in a general manner another multi-hull vessel;

5 Figure 2E is a vertical section along line IIE-IIE of Figure 2A;

Figure 2F is a horizontal section taken along the line IIF-IIF of Figure 2D;

10 Figure 2G is a diagrammatic perspective view showing in a general manner a process of construction of the latter multi-hull vessel;

Figures 3A to 3D are diagrammatic alternate side elevations and a diagrammatic end elevation showing in a general manner a further multi-hull vessel;

15 Figures 4A to 4E are views corresponding to Figures 2A to 2D and 2G of a yet further multi-hull vessel and the process of construction thereof;

Figures 5A to 5D are views corresponding to Figures 3A to 3D of a yet still further multi-hull vessel;

20 Figures 6A to 6D are views corresponding to Figures 2A to 2G of another multi-hull vessel and the process of construction thereof;

Figures 6E and 6F are vertical sections taken along lines VIE-VIE and VIF-VIF of Figure 6A;

25 Figure 6G is a diagrammatic perspective view showing in a general manner the process of construction of the latter multi-hull vessel;

Figures 7A to 7D are views corresponding to Figures 3A to 3C of a further multi-hull vessel;

30 Figure 8 is a diagrammatic perspective view showing in a general manner steps in a process of construction of a multi-hull vessel according to Figures 1A, 1B and 1D; 3A, 3B and 3D; 5A, 5B, and 5D; or 7A, 7B and 7D;

35 Figure 9 is a diagrammatic perspective view showing in a general manner steps in a process of construction of a multi-hull vessel according to Figures 1A, 1C and 1D; 3A, 3C and

3D; 5A, 5C and 5D; or 7A, 7C and 7D;

Figures 10A to 10C are diagrammatic side elevations showing possible variations in the relative locations of unitary parts of the multi-hull vessels of Figures 2A to 7D;

5 Figures 11A to 11C are diagrammatic side elevations showing possible variations in the relative locations of unitary parts of the multi-hull vessels of Figures 1A to 7D;

10 Figures 12A to 12C are diagrammatic side elevations showing possible variations in the relative locations of further unitary parts of the multi-hull vessels of Figures 2A to 7D;

Figures 13A to 13D are diagrammatic cross-sections showing possible variations in the relative locations of the unitary parts of Figures 1A to 7D;

15 Figure 14A is a diagrammatic plan showing an opening of substantially circular cross-section in any one of the multi-hull vessels;

Figures 14B and 14C are vertical sections taken along lines XIVB-XIVB and XIVC-XIVC of Figure 14A;

20 Figures 15A is a diagrammatic plan showing an opening of substantially rectangular cross-section in any one of the multi-hull vessels;

Figure 15B is vertical section taken along line XVB-XVB of Figure 15B;

25 Figures 16A to 16H are diagrammatic perspective views showing in a general manner dismantling multi-hull vessels according to Figures 1A to 7D and constructing new multi-hull vessels according to those Figures;

30 Figures 17A to 17C are diagrammatic perspective views showing in a general manner dismantling multi-hull vessels according to Figures 3A to 3D and constructing a new multi-hull vessel according to those Figures;

35 Figures 18A and 18B are diagrammatic perspective views showing in a general manner dismantling a multi-hull vessel according to Figures 2A to 2F and constructing a new multi-

hull vessel according to those Figures;

Figures 19A to 19C are diagrammatic perspective views showing in a general manner dismantling of multi-hull vessels according to Figures 5A to 5D and constructing of a multi-hull vessel according to those Figures;

Figures 20A and 20B are diagrammatic perspective views showing in a general manner dismantling of a multi-hull vessel according to Figures 4A to 4D and constructing of a new multi-hull vessel according to those Figures;

Figures 21A to 21D are diagrammatic perspective views showing in a general manner the dismantling of multi-hull vessels according to Figures 4A to 5D and the constructing of new multi-hull vessels according to those Figures;

Figures 22A to 22D are diagrammatic perspective views showing in a general manner dismantling of multi-hull vessels according to Figures 1A to 1D and 7A to 7D and the constructing of new multi-hull vessels according to those Figures;

Figures 23A and 23B are diagrammatic perspective views showing in a general manner dismantling of a multi-hull vessel according to Figures 6A to 6F and constructing of a new multi-hull vessel according to those Figures;

Figures 24A to 24H and 24J to 24M are diagrammatic perspective views showing in a general manner dismantling of multi-hull vessels according to Figures 2A to 7D and constructing of new multi-hull vessels according to those Figures;

Figure 25 is a diagrammatic perspective view of a multi-hull vessel according to Figures 1A to 1D to be used as a floating, production, drilling, storage and offloading vessel;

Figure 26 is a diagrammatic perspective view of a process of use of a typical mono-hull vessel in a central mono-hull in a new multi-hull vessel somewhat according to Figures 4A to 4D;

Figure 27 is a diagrammatic perspective view of a process of use of a typical mono-hull vessel in a central mono-hull in a new multi-hull vessel somewhat according to Figures 6A to 6F and to be used as a drilling vessel;

5 Figure 28 is a diagrammatic perspective view of a process of conversion of the multi-hull drilling vessel of Figure 27 back into a mono-hull vessel;

10 Figure 29 is a diagrammatic perspective view of a multi-hull vessel somewhat according to Figures 6A to 6F and to be used as a drilling, production, storage and off-loading vessel;

15 Figure 30 is a diagrammatic perspective view illustrating in more detail a process of conversion of a mono-hull vessel into a multi-hull vessel according to Figures 2A to 2F and to be used as a drilling ship;

Figure 31 is a view similar to Figure 30 of a process of conversion of the multi-hull drilling vessel back into the mono-hull vessel, and

20 Figure 32 is a perspective view of a further multi-hull vessel to be used as a drilling vessel.

The following reference numerals refer to the following items:-

- 2. Multi-hull vessel;
- 4. Outer mono-hull in the form of a single mono-hull;
- 25 4'. Outer mono-hull in the form of a plurality of sub-hulls;
- 6. Transition section to an outer mono-hull 4;
- 6'. Transition section to an outer mono-hull 4';
- 8. Generally horizontal projecting structure;
- 30 8A. Frames of structure 8;
- 10. Longitudinal transition section;
- 12. Generally horizontal central structure;
- 14. Generally horizontal continuous structure;
- 14A. Frames of structure 14;
- 35 16. U-shaped transition section;

- 18. Central transition section;
- 20. Existing or newly built central mono-hull;
- 20A. Ship's crew's accommodation;
- 20B. Side shell of hull 20;
- 5 20C. Webframes or bulkheads of hull 20;
- 20D. Deck of hull 20;
- 22. Decks on or within structures and/or transition sections;
- 24. Equipment opening, circular and through one of the
- 10 24'. Equipment opening, rectangular and through one of the structures;
- 26. Retractable and/or removable screen, circular in the opening 24;
- 15 26'. Retractable screen, rectangular for the opening 24' and retractable to the underside of the structures;
- 28. Equipment on central mono-hull deck;
- 28A. Equipment on deck;
- 20 28B. Equipment in structures;
- 30. Derrick;
- 30A. Derrick opening;
- 30'. Possible derrick;
- 30'A. Possible derrick opening;
- 25 32. Thrusters;
- 34. Operating crew's accommodation
- 34A. Helideck (helicopter landing deck);
- 36. Turret;
- 36A. Turret opening in structure;
- 30 36B. Flare;
- 38. Operating crew's accommodation partly in structure;
- 40. Assemblies of outer mono-hulls and projecting structures;
- 35 40'. Assemblies of outer mono-hulls, outer mono-hull

transition sections and projecting structures;

Figures 1A to 1D show a twin-hulled vessel 2 incorporating, as unitary parts, port and starboard outer mono-hulls 4 (or 4') as clearly seen in Figures 1B and 1C, connected to a generally horizontal continuous structure 14 by port and starboard transition sections 6 (or 6').

Figure 1E illustrates a process of construction in which the port and starboard outer mono-hulls 4 (or 4') are connected to the port and starboard transition sections 6 (or 6'), and two assemblies 4, 6, (or 4', 6'), thus formed are connected by the transition sections 6 (or 6') to the generally horizontal continuous structure 14. One way of assembling the multi-hull vessel 2 consists of connecting the respective transition sections 6 (or 6') to the respective outer mono-hulls 4 (or 4') and then lowering the structure 14 onto the transition sections 6 (or 6') and connecting the sections 6 (or 6') to the structure 14.

Figures 2A to 2D show a multi-hull vessel 2 with a central mono-hull 20 and port and starboard outer mono-hulls 4 (or 4') which are connected to the central mono-hull 20 by port and starboard generally horizontal projecting structures 8 and port and starboard longitudinal transition sections 10.

Figures 2E and 2F show in more detail the fixing of one of the transition sections 10 between the structure 8 and the central mono-hull 20. The transition section 10 accommodates the differences between the pitches of the webframes 20C and other strengthening members of the hull 20 and the pitches of frames 8A and other strengthening members of the structure 8.

Figure 2G shows a process of construction of a multi-hull vessel 2 in which the port and starboard assemblies each consisting of an outer mono-hull 4 (or 4') and that are integral with the generally horizontal projecting structure 8, are connected to the port and starboard longitudinal transition sections 10, and the port and starboard assemblies thus formed are connected by the port and starboard

longitudinal transition sections 10 to the side shell 20B of the central mono-hull 20.

Figures 3A to 3D show a multi-hull vessel 2 which differs from that of Figures 2A to 2F in that the outer mono-hulls 4 (or 4') are connected by transition sections 6 (or 6'), to the projecting structures 8.

Figures 4A to 4D show a multi-hull vessel 2 with a central mono-hull 20, and port and starboard outer mono-hulls 4 (or 4'), integral with port and starboard generally horizontal projecting structures 8 themselves connected by port and starboard longitudinal transition sections 10 to a central structure 12, a central transition section 18, and the central mono-hull 20. The structure 12 is connected by the section 18 to the deck of the hull 20.

Figure 4E shows a process of construction of a multi-hull vessel 2 in which the structure 12 is connected to the transition section 18 and the assembly thus formed is connected by the section 18 to the deck of the mono-hull 20. Meanwhile, the assemblies 40 each consisting of a port and starboard outer mono-hull 4 (or 4') that is integral with the port and starboard generally horizontal projecting structure 8, are connected to port and starboard longitudinal transition sections 10 and the assemblies 40 and 10 thus formed are then connected by the transition sections 10 to the central structure 12, the central transition section 18, and the central mono-hull 20. In some circumstances the longitudinal transition sections 10 may be connected to only the side shells of the central mono-hull 20, i.e. not directly to the central transition section 18 and/or the central structure 12.

Figures 5A to 5D show a multi-hull vessel 2 which differs from that of Figures 4A to 4D in that the outer mono-hulls 4 (or 4'), are connected by transition sections 6, (or 6'), to the projecting structures 8.

Figures 6A to 6F show a multi-hull vessel 2 with a

central mono-hull 20 and port and starboard outer mono-hulls 4 (or 4'), which are connected integrally to the generally horizontal continuous structure 14 itself connected by a central transition section 18 to the central mono-hull 20.

5 As shown in Figures 6E and 6F, the transition section 18 accommodates the pitches of the frames 14A and other strengthening members of the structure 14 to those of the webframes and/or bulkheads 20C and other strengthening members of the central hull deck 20D. The structure 14 may
10 provide a deck that is situated above, and connected to, the central hull deck 20D by the central transition section 18. Additional local strengthening of the central mono-hull deck 20D at the connection to the transition section 18 is provided.

15 Figure 6G illustrates a process of construction of a multi-hull vessel 2 in which the central transition section 18 is connected to the generally horizontal continuous structure 14 integral with the outer mono-hulls 4 (or 4'), and then the assembly 4 (or 4'), 14 and 18 thus formed is
20 connected by the section 18 to the deck of the central mono-hull 20.

Figures 7A to 7D show a multi-hull vessel 2 which differs from that of Figures 6A to 6F in that the outer mono-hulls 4 (or 4') are connected to the continuous structure 14
25 by outer transition sections 6 (or 6').

Figure 8 shows a process of construction of a multi-hull vessel 2 in which single port and starboard outer mono-hulls 4 are connected to single port and starboard outer mono-hull transition sections 6 and the assemblies 4 and 6 thus formed
30 are connected by the sections 6 to the port and starboard generally horizontal projecting structures 8, or the generally horizontal continuous structure 14.

Figure 9 shows a process of construction of a multi-hull vessel 2 in which two or more port and starboard outer mono-hulls 4' are connected to two or more port and starboard
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outer mono-hull transition sections 6' and the assemblies 4' and 6' thus formed are connected by the sections 6' to the port and starboard generally horizontal projecting structures 8, or the generally horizontal continuous structure 14.

5 Figures 10A to 10C show possible variations in the locations of the longitudinal extremities of the port and starboard outer mono-hulls 4 (or 4') and, where provided, the port and starboard outer mono-hull transition sections 6 (or 6'), relative to the longitudinal extremities of the central
10 mono-hull 20.

 Figures 11A to 11C show possible variations in the locations of the longitudinal extremities of the port and starboard outer mono-hulls 4 (or 4'), and, where provided, the port and starboard outer mono-hull transition sections 6
15 (or 6'), relative to the longitudinal extremities of the port and starboard generally horizontal projecting structures 8, and/or the generally horizontal continuous structure 14.

 Figures 12A to 12C show possible variations in the locations of the longitudinal extremities of the port and
20 starboard generally horizontal projecting structures 8, the port and starboard longitudinal transition sections 10, and/or the central structure 12 where provided, and/or the central transition section 18 where provided, and/or the generally horizontal continuous structure 14, relative to the
25 longitudinal extremities of the central mono-hull 20.

 Figures 13A to 13D show possible variations in the locations of the laterally outer edges of the port and starboard outer mono-hulls 4 (or 4'), and, where provided, the port and starboard outer mono-hull transition sections 6
30 (or 6'), relative to the laterally outer edges of the port and starboard generally horizontal projecting structures 8, and/or the generally horizontal continuous structure 14, and/or any decks 22 attached to these structures.

 Figures 14A to 14C show a circular equipment opening 24
35 (although it could be of any desired shape, for example

rectangular) formed through one or more of the structures 8 and 14 the decks 22 and receiving retractable and/or removable screens 26 for protecting the equipment 28B.

Figures 15A and 15B show a rectangular equipment opening 24' formed through one or more of the structures 8 and 14 and the decks 22 and receiving equipment 28B protectable by one or more retractable screens 26'.

Figures 16A to 16D show the removal, from existing multi-hull vessels 2, of the port and starboard outer mono-hulls 4 (or 4'), from the port and starboard outer mono-hull transition sections 6, for re-use on new multi-hull vessels 2, as shown in Figures 16E to 16H with new port and starboard outer mono-hull transition sections 6.

Figures 17A and 17B show the removal from existing multi-hull vessels 2 according to Figures 3A to 3D, of either as shown in Figure 17A, of the port and starboard generally horizontal projecting structures 8, or alternatively, as shown in Figure 17B, port and starboard assemblies 40' each consisting of the outer mono-hulls 4 (or 4'), outer mono-hull transition sections 6 (or 6') and the generally horizontal projecting structure 8, for re-use on a new multi-hull vessel 2, as shown in Figure 17C, in conjunction with either new port and starboard outer mono-hull transition sections 6 (or 6'), new port and starboard outer mono-hulls 4 (or 4'), new port and starboard longitudinal transition sections 10.

Figure 18A shows the removal, from an existing multi-hull vessel 2 according to Figures 2A to 2F, of the port and starboard assemblies 40 each consisting of the generally horizontal projecting structure 8, with integral outer mono-hulls 4, for re-use on a new multi-hull vessel, as shown in Figure 18B, in conjunction with new port and starboard longitudinal transition sections 10.

Figures 19A and 19B show the removal, from existing multi-hull vessels 2 according to Figures 5A to 5D, of either, as shown in Figure 19A, the port and starboard

generally horizontal projecting structures 8, or alternatively, as shown in Figure 19B, the removal of the port and starboard assemblies 40' each consisting of the outer mono-hull 4 (or 4'), the outer mono-hull transition section 6 and the generally horizontal projecting structure 8, for re-use on a new multi-hull vessel 2, as shown in Figure 19C, in conjunction with either new port and starboard outer mono-hull transition sections 6 (or 6'), new port and starboard outer mono-hulls 4 (or 4'), or alternatively, new port and starboard longitudinal transition sections 10.

Figure 20A shows the removal, from an existing multi-hull vessel 2 according to Figures 5A to 5D, of the port and starboard assemblies 40 each consisting of the generally horizontal projecting structure 8, with integral outer mono-hull 4 (or 4'), for re-use on a new multi-hull vessel, as shown in Figure 20B, in conjunction with new port and starboard longitudinal transition sections 10..

Figures 21A and 21B show the removal, from existing multi-hull vessels 2 according to Figures 4A to 4D and 5A to 5D, of the central structure 12, for re-use on new multi-hull vessels 2, as shown in Figures 21C and 21D, in conjunction with a new central transition section 18, and new port and starboard longitudinal transition sections 10.

Figures 22A and 22B show the removal, from existing multi-hull vessels 2 according to Figures 1A to 1D and 7A to 7D, of the generally horizontal continuous structures 14 for re-use on new multi-hull vessels 2, as shown in Figures 22C and 22D, in conjunction with new port and starboard outer mono-hull transition sections 6 (or 6') and new port and starboard outer mono-hulls 4 (or 4'), and, in respect of Figure 22D, a new central transition section 18.

Figure 23A shows the removal, from an existing multi-hull vessel according to Figures 6A to 6F, of the generally horizontal continuous structure 14, with integral port and starboard outer mono-hulls 4 (or 4'), for re-use on a new

multi-hull vessel, as shown in Figure 23B, in conjunction with a new central transition section 18.

Figures 24A to 24F show the removal from existing multi-hull vessels 2 according to Figures 2A to 7D, of the central mono-hull 20, for re-use on new multi-hull vessels, as shown in Figures 24G, 24H and 24J to 24M, in conjunction with new port and starboard longitudinal transition sections 10, and/or a new central transition section 18.

Figure 25 shows in detail a multi-hull vessel 2 according to Figures 1A, 1B and 1D equipped as a floating, production, drilling, storage and off-loading vessel for oil and/or gas. The vessel 2 is equipped with on-deck drilling and production equipment 28A, in-structure equipment drilling and production equipment 28B, one or more derricks 30 (and 30'), one or more derrick openings 30A (and 30'A) through the continuous structure 14, crew's accommodation 20A and 34 (or 38), thrusters 32, a helideck 34A, a turret 36, a turret opening 36A through the structure 14 and a Flare 36B. For a vessel to which is to be used for drilling only, the production equipment in 28A and 28B, the turret 36, the turret opening 36A and Flare 36B would be omitted. Similarly, for a vessel 2 which is to be used for production, storage and off-loading only, the production equipment in 28A and 28B, the derrick(s) 30 (and 30') and the derrick opening(s) 30A (and 30'A) would be omitted.

Figure 26 shows a process of conversion similar to that of Figure 4E, but in which the transition section 18 is connected to the structure 12 and the equipment 28A and 28B, the derrick 30, the derrick opening 30A and the accommodation 34 are provided on or in the structure 12 and then the assemblies 40

each consisting of an outer mono-hull 4 and a projecting structure 8, with on-deck and in-deck equipment 28A and 28B and incorporating thrusters 32, are connected to the assembly 12, 18, 28A, 28B, 30, 34 and 34A (or 38) by way of the transition sections 10 and finally the assembly 4, 8, 10, 12, 18, 28A, 28B, 30, 34 and 34A (or 38) is connected to the central mono-hull 20 by the section 18.

Figure 27 shows a process of conversion basically the same as that of Figure 26, but with equipment 28A and 28B, derrick(s) 30 (and 30'), thrusters 32 and accommodation 34 (or 38) being mounted on the assembly 4 and 14 before the section 18 is connected to the deck of the hull 20.

Figure 28 shows that in the dismantling process the assembly 4, 14, 18, 28A, 28B, 30 (30'), 32, 34 and 34A (or 38) is disconnected from the mono-hull 20 and then the transition section 18 is removed.

Figure 29 shows a multi-hull vessel 2 according to Figure 27, except that the assembly 4, 14, 18, 28A, 28B, 30 (30'), 32, 34, 34A (or 38) and 36B also incorporates a turret 36 and a turret opening 36A disposed forward of the bows of the central mono-hull 20.

The multi-hull drilling vessel 2 of Figure 30 comprises a central mono-hull 20 which may be an existing tanker with its superstructure removed (except for the crew's accommodation 20A) or a newly built mono-hull, and two assemblies 40 each of which consists of an outer mono-hull 4 and a generally horizontal structure 8, each of which may be of a standard design, each assembly 40 being connected to a side shell 20B of the central hull 20 by a transition section 10 at an inner vertical connection face of the assembly 40. Accommodation 20A for the

ship's crew is provided at the stern of the central hull 20, whilst forward of that accommodation is accommodation 34 for the drilling crew, with a helideck 34A thereon. A derrick 30 is provided above a starboard derrick opening 30A on the starboard structure 8 for use in gas and/or oil drilling. Alternatively or additionally, a derrick 30' (shown in chain lines) could be mounted on the port structure 8 above a port derrick opening 30'A through the port structure. Each outer hull 4 is provided with a pair of thrusters 32 for use in keeping the vessel 2 in a stable position when the vessel is operating. Drilling and other equipment 28A and 28B can be located in or on the structures 8 or, by way of supports, on the deck of the central hull 20. The structure 8 may provide deck areas that can be generally level with the central hull deck or with the equipment supports located on the central hull deck. Additional local strengthening is provided of the central mono-hull side shells at the connections to the transition sections 10.

As shown in Figure 30, to construct this multi-hull vessel, the structure 8 in each of the assemblies 40 has fixed to it at its vertical connection face a transition section 10 that is purpose-built for connection to the particular central mono-hull 20. The assemblies 40 each consisting of hull 4 and the structure 8, the transition sections 10, the thrusters 32 and outer equipment 28A and 28B are connected to the side shells 20B of the central mono-hull 20. The inner equipment 28 and its supports, and the accommodation 34 for the drilling crew, with the helideck 34A provided on its roof, are installed on the deck 20D of the central mono-hull 20.

By using the transition sections 10 to construct the multi-hull vessel 2, a mono-hull tanker or newly built mono-hull can be converted into a multi-hull drilling ship using outer hulls 4 and structures 8, both of which may be of a standard design. Only the transition sections 10 have to be purpose-made, being designed and built to fit the outer mono-hulls 4 and projecting structures 8 to the particular tanker.

An important advantage of this method of constructing a multi-hull vessel 2 is that, once the multi-hull vessel is no longer needed, and as shown in Figure 31, the assemblies 40, the transition sections 10 and other additions such as the equipment 28 and its supports, accommodation 34 and helideck 34A, can be stripped from the central mono-hull 20 to return to the original mono-hull tanker. The longitudinal transition sections 10 can be scrapped or modified for future use. The assemblies 40 can be re-used as appropriate in any future conversion of a different mono-hull tanker or newly built hull to a multi-hull vessel using new transition sections 10 when the new central mono-hull webframe pitch differs from that of the previous central mono-hull. In this way, the conversion of a tanker or newly built hull to and from a multi-hull vessel is greatly facilitated by being cheaper and quicker and the amount of material waste is reduced. Greater flexibility in construction is achieved.

In the embodiment of Figure 32, which is a multi-hull vessel 2 for drilling, production, storage and offloading of oil and/or gas, the generally horizontal continuous structure 14 is of U-shape and horizontally embraces the hull 20, with a U-shaped transition section 16 fixing the structure 14 to the hull 20 and/or its deck 20D. A derrick 30 (or 30') is mounted above a derrick opening 30A (or 30'A)

formed through the structure 14 starboard of the hull 20. A turret 36 over a turret opening 36A through the structure 14 allows risers and other equipment connected to wells on the seabed to pass through the structure. Moreover, production equipment 28A (or 28B) is stored in or on the structure. A flare 36B is provided to burn off gas and liquids generated during oil and/or gas production. Again, by omission of relevant items, the multi-hull vessel 2 can serve for drilling only or for production, storage and off-loading only.

Depending on the intended use of the vessel, multi-hull vessels having three or five or any number of hulls may be used.

The present multi-hull vessels are able to operate in shallower water depths than a semi-submersible vessel and in approximately the same water depths as a mono-hull vessel, thus allowing them to be used in inland waterways.

For construction of one of the present multi-hull vessels, work could be carried out simultaneously in two (or more) shipyards, as follows:-

Shipyard 1. This yard converts an existing mono-hull tanker, or other suitable vessel, by strengthening it at the intended connections to the transition section(s) 10 and 18, as the case may be, or builds a new central mono-hull.

Shipyard 2. This yard builds the outer hulls 4 and the structure(s) 8, or 8 and 12, or 14, as the case may be, and the relevant transition section(s) complete with all of the equipment in place during the same period of time that Shipyard 1 is carrying out the work on the central hull 20.

The outer hulls and the structure(s) could be transported by barge from Shipyard 2 to Shipyard 1, for assembly with the central mono-hull 20. Instead, if the outer hulls and the structure(s) form, or could be formed into, a catamaran-type of vessel, the latter could be towed from Shipyard 2 to Shipyard 1, for assembly with the central mono-

hull.

Alternatively, the completed central mono-hull from Shipyard 1, and the outer hulls and structure(s) from Shipyard 2, could both be taken to a different yard for assembly.

For conversion back to the original use of central mono-hull 20, the outer hulls, the structure(s), and the transition section(s), together with any equipment on or in the structure(s), could be detached at the external face of the central mono-hull deck or side shells.

Any existing local strengthening modifications within the central hull 20, or under its deck 20D which would include the side shells 20B, or the webframes and bulkheads 20C, could be left in place since they would have little effect on the vessel when it is returned to its original use. Any equipment and support structures on the central mono-hull deck 20D would be removed.

Where the outer hulls 4 (or 4'), the transition section(s) and the structure(s) form a catamaran-type vessel, the central mono-hull 20 could be ballasted down and the outer hulls and structure(s) be removed and floated off. This operation could be carried out in sheltered water, avoiding the need to use a shipyard.

Either method would allow the outer hulls and structure(s) with equipment to be re-used on other mono-hull vessels after they have been removed from the original mono-hull vessel. Construction of new transition section connections to another central hull may be necessary, but the total cost would be considerably less than the cost of building new outer hulls and structure(s).

CLAIMS

1. A method of constructing a multi-hull vessel comprising fixing a first unitary part of the vessel to a second unitary part of the vessel by way of a transition section structurally interconnecting structural elements of the first unitary part with structural elements of the second unitary part.

2. A method according to claim 1 and further comprising using said multi-hull vessel for oil and/or gas and/or drilling and/or production.

3. A method according to claim 1 or 2, wherein said fixing is preceded by providing by providing as said first unitary part an existing mono-hull vessel having internal structural elements and refraining from significantly altering said internal structural elements.

4. A method according to any preceding claim, and further comprising subsequently detaching said second unitary part and said transition section from said first unitary part.

5. A multi-hull vessel comprising a first unitary part comprised of first structural elements, a second unitary part comprised of second structural elements, and a transition section whereby said first structural elements are connected to said second structural elements.

6. A vessel according to claim 5, wherein said first unitary part comprises a generally horizontal structure.

7. A vessel according to claim 6, wherein said second unitary part is a port outer hull and the vessel further comprises a third unitary part in the form of a starboard outer hull and a second transition section whereby structural elements of the third unitary part are connected to structural elements of said first unitary part.

8. A vessel according to claim 5, wherein said second unitary part comprises a generally horizontal structure.

9. A vessel according to claim 8, wherein said second

unitary part comprises port and starboard outer hulls.

10. A vessel according to claim 8, and further comprising third and fourth unitary parts in the form of port and starboard outer hulls and second and third transition
5 sections connecting structural parts of the third and fourth unitary parts to structural parts of the second unitary part.

11. A vessel according to claim 8, 9, or 10, wherein said first unitary part is a central mono-hull.

12. A vessel according to claim 5, and further
10 comprising a third unitary part comprised of third structural elements, and a second transition section whereby said third structural elements are connected to structural elements of said first unitary part.

13. A vessel according to claim 12, wherein said first
15 unitary part is a central mono-hull.

14. A vessel according to claim 13, wherein the second and third unitary parts are generally horizontal structures laterally projecting to port and starboard of said first unitary part.

20 15. A vessel according to claim 14, and further comprising a fourth unitary part in the form of a generally horizontal central structure and a third transition section connecting structural elements of said fourth unitary part to structural elements of at least one of the other unitary
25 parts.

16. A vessel according to claim 14 or 15, and further comprising two further unitary parts in the form of port and starboard outer hulls and two further transition sections connecting structural elements of the two further unitary
30 parts with structural elements of the second and third unitary parts, respectively.