CLAIMS

1. A yoke mooring system for connecting a floating vessel to a tower structure at sea, comprising:

a support structure;

one or more extension arms suspended from the support structure;

a ballast tank connected to the one or more extension arms;

a yoke extending from and connected to the ballast tank at a first end thereof, the yoke comprising a tower connector disposed on a second end thereof;

a first winch system located on the support structure, the first winch system connected to the yoke proximate the second end of the yoke via a first line or cable; ~~and~~

a second winch system connected to the ballast tank via a second line or cable;

and

at least one of: (i) one or more first transit arms connected at one end thereof to the support structure and connected to the ballast tank at a second end thereof, and (ii) one or more second transit arms connected at one end thereof to the support structure and connected to the yoke at a second end thereof, wherein, the one or more first transit arms, if present, is configured to prevent the ballast tank from moving independent of the vessel, and wherein the one or more second transit arms, if present, is configured to prevent the yoke from moving independent of the vessel.

2. The system of claim 1, wherein the first winch system is disposed above the yoke and located on the support structure.

3. The system of claim 1, wherein the second winch system is disposed beneath the first winch system, and substantially lateral to the ballast tank.

4. The system of claim 1, wherein the tower connector comprises a mating hub having a recess and a notched profile disposed on an outer surface thereof, the hub being an annular member having a bore formed therethrough.

5. The system of claim 1, wherein the first and second winch systems are each electric, pneumatic, hydraulic or a combination thereof.

6. The system of claim 1, wherein the first and second winch systems comprise both electric and hydraulic actuated components.

7. The system of claim 1, further comprising a third winch system connected to the ballast tank via a third line or cable, the third winch system configured to control side to side movement of the ballast tank.

8. The system of claim 1, wherein the system comprises the ~~further comprising~~ one or more first transit arms ~~connected at one end thereof to the support structure and connected to the ballast tank at a second end thereof, the one or more transit arms configured to prevent the ballast tank from moving independent of the vessel~~.

9. The system of claim 1, wherein the system comprises the ~~further comprising~~ one or more second transit arms ~~connected at one end thereof to the support structure and connected to the yoke at a second end thereof, the one or more transit arms configured to prevent the yoke from moving independent of the vessel~~.

10. A method for mooring a floating vessel to a tower structure at sea, comprising:

providing a floating vessel comprising:

a support structure mounted on an upper deck thereof;

one or more extension arms suspended from the support structure;

a ballast tank connected to the one or more extension arms;

a yoke extending from and connected to the ballast tank at a first end thereof, the yoke comprising a tower connector disposed on a second end thereof;

a first winch system located on the support structure, the first winch system connected to the yoke proximate the second end of the yoke via a first line or cable; ~~and~~

a second winch system connected to the ballast tank via a second line or cable; and

at least one of: (i) one or more first transit arms connected at one end thereof to the support structure and connected to the ballast tank at a second end thereof, and (ii) one or more second transit arms connected at one end thereof to the support structure and connected to the yoke at a second end thereof, wherein the one or more first transit arms, if present, is configured to prevent the ballast tank from moving independent of

the vessel, and wherein the one or more second transit arms, if present, is configured to prevent the yoke from moving independent of the vessel;

locating the vessel close to the tower structure, the tower structure comprising a yoke head connector affixed thereto, the yoke head connector adapted to receive the tower connector;

releasing, if present, the one or more first transit arms from the ballast tank and, if present, the one or more second transit arms from the yoke to permit the yoke and the ballast tank to move with respect to the vessel;

pulling the vessel toward the tower structure using a pull-in winch system located on the vessel and connected to the tower structure via a pull-in line or cable;

aligning the tower connector and the yoke head connector;

controlling vertical movement of the yoke using the first winch system located on the support structure; and

actuating a hydraulic cylinder within the yoke head connector to mechanically link the tower connector to the yoke head connector.

11~~13~~. The method of claim 10, wherein the second winch system is located on the vessel below the first winch system.

12~~15~~. The method of claim 10, wherein the first winch system is located above the ballast tank, and wherein the second winch system and the pull-in winch system are located on the vessel below the first winch system.

13~~17~~. The method of claim 10, wherein each winch system is electric, pneumatic, hydraulic or a combination thereof.

14~~18~~. The method of claim 10, wherein each winch system comprises both electric and hydraulic actuated components.

15~~19~~. The method of claim 10, wherein the floating vessel ~~further~~ comprises the one or more first transit arms ~~connected at one end thereof to the support structure and connected to the ballast tank at a second end thereof, the one or more transit arms configured to prevent the ballast tank from moving independent of the vessel~~.

16~~20~~. The method of claim 10, wherein the floating vessel ~~further~~ comprises the one or more second transit arms ~~connected at one end thereof to the support structure and connected to the yoke at a second end thereof, the one or more transit arms configured to prevent the yoke from moving independent of the vessel~~.

17~~21~~. The system of claim 1, wherein the ballast tank comprises a ballast medium disposed within an internal volume thereof such that the ballast tank is configured to serve as a counterbalance or restoring force as the vessel moves at sea.

18~~22~~. The system of claim 1, wherein the system comprises the ~~further comprising:~~
one or more first transit arms ~~connected at one end thereof to the support structure and connected to the ballast tank at a second end thereof, the one or more first transit arms configured to prevent the ballast tank from moving independent of the vessel;~~ and
the one or more second transit arms ~~connected at one end thereof to the support structure and connected to the yoke at a second end thereof, the one or more second transit arms configured to prevent the yoke from moving independent of the vessel~~.

19~~23~~. The method of claim 10, wherein the ballast tank comprises a ballast medium disposed within an internal volume thereof such that the ballast tank is configured to serve as a counterbalance or restoring force as the vessel moves at sea.

20~~24~~. The method of claim 10, further comprising controlling side to side movement of the ballast tank using a third winch system disposed on the vessel and connected to the ballast tank via a third line or cable.

21. A yoke mooring system for connecting a floating vessel to a tower structure at sea, comprising:

a support structure;

one or more extension arms suspended from the support structure;

a ballast tank connected to the one or more extension arms;

a yoke extending from and connected to the ballast tank at a first end thereof, the yoke comprising a tower connector disposed on a second end thereof;

a first winch system located on the support structure, the first winch system connected to the yoke proximate the second end of the yoke via a first line or cable;

a second winch system connected to the ballast tank via a second line or cable;

and

a third winch system connected to the ballast tank via a third line or cable for controlling side to side movement of the ballast tank.

22. A method for mooring a floating vessel to a tower structure at sea, comprising:

providing a floating vessel comprising:

a support structure mounted on an upper deck thereof;

one or more extension arms suspended from the support structure;

a ballast tank connected to the one or more extension arms;

a yoke extending from and connected to the ballast tank at a first end thereof, the yoke comprising a tower connector disposed on a second end thereof;

a first winch system located on the support structure, the first winch system connected to the yoke proximate the second end of the yoke via a first line or cable;

a second winch system connected to the ballast tank via a second line or cable; and

a third winch system connected to the ballast tank via a third line or cable for controlling side to side movement of the ballast tank;

locating the vessel close to the tower structure, the tower structure comprising a yoke head connector affixed thereto, the yoke head connector adapted to receive the tower connector;

pulling the vessel toward the tower structure using a pull-in winch system located on the vessel and connected to the tower structure via a pull-in line or cable;

aligning the tower connector and the yoke head connector;

controlling vertical movement of the yoke using the first winch system located on the support structure;

controlling side to side movement of the ballast tank using the third winch system; and

actuating a hydraulic cylinder within the yoke head connector to mechanically link the tower connector to the yoke head connector.