Claims

1. A system for securing a vessel floating on a surface of a body of water in a stabilized position, comprising:

a first vessel support structure and a second vessel support structure, each disposed on the vessel, each vessel support structure comprising:

one or more extension arms, each having a first end and a second end, wherein the first end of the one or more extension arms is suspended from the vessel support structure;

a ballast tank connected to the second end of the one or more extension arms; and

a yoke having a first end and a second end, the first end connected to the ballast tank and the second end comprising a yoke head disposed thereon; and

a first mooring support structure and a second mooring support structure, each fixed in place, and each mooring support structure comprising a pitch bearing, wherein:

the yoke head of the first vessel support structure is connected to the pitch bearing of the first mooring support structure,

the pitch bearing of the first mooring support structure is configured to allow the yoke of the first vessel support structure to pivot about a horizontal axis relative to the first mooring support structure,

the yoke head of the second vessel support structure is connected to the pitch bearing of the second mooring support structure,

the pitch bearing of the second mooring support structure is configured to allow the yoke of the second vessel support structure to pivot about a horizontal axis relative to the second mooring support structure, and

the system is configured to provide restoring forces between the first and second mooring support structures and the floating vessel in response to external environmental forces acting on the vessel.

2. The system of claim 1, wherein the first mooring support structure further comprises a turntable configured to at least partially rotate about a vertical axis of the first mooring support structure, and wherein the pitch bearing of the first mooring support structure is connected to the turntable.

3. The system of claim 1, wherein the yoke head of the first vessel support structure comprises a roll bearing configured to allow the yoke to rotate relative to the first mooring support structure along a longitudinal axis of the yoke head.

4. The system of claim 1, wherein the second mooring support structure further comprises a turntable configured to at least partially rotate about a vertical axis of the second mooring support structure, and wherein the pitch bearing of the second mooring support structure is connected to the turntable.

5. The system of claim 1, wherein the yoke head of the second vessel support structure comprises a roll bearing configured to allow the yoke to rotate relative to the second mooring support structure along a longitudinal axis of the yoke head.

6. The system of claim 1, wherein the system restricts the vessel from rotating relative to a surface of the earth.

7. The system of claim 1, wherein at least one of the first and second mooring support structures is fixed to a seabed.

8. The system of claim 1, wherein at least one of the first and second mooring support structures is fixed to a coastal defense structure.

10. The system of claim 1, wherein the ballast tank of the first vessel support structure is located above the surface of the body of water.

11. The system of claim 1, wherein the ballast tank of the first vessel support structure is located below the surface of the body of water.

14. The system of claim 1, wherein the pitch bearing of the first mooring support structure is located above the surface of the body of water.

15. The system of claim 1, wherein the pitch bearing of the first mooring support structure is located below the surface of the body of water.

18. The system of claim 1, further comprising a transfer system disposed between the first vessel support structure and the first mooring support structure, the transfer system configured to convey a fluid, electrical power, or a combination thereof from the vessel to the first mooring support structure or from the first mooring support structure to the vessel.

19. A system for securing a vessel floating on a surface of a body of water in a stabilized position, comprising:

a first vessel support structure and a second vessel support structure, each disposed on the vessel, each vessel support structure comprising:

one or more extension arms, each having a first end and a second end, wherein the first end of the one or more extension arms is suspended from the vessel support structure;

a weight connected to the second end of the one or more extension arms; and

a yoke having a first end and a second end, the first end connected to the weight and the second end comprising a yoke head disposed thereon;

a first mooring support structure and a second mooring support structure, each fixed in place, and each mooring support structure comprising a pitch bearing, wherein:

the yoke head of the first vessel support structure is connected to the pitch bearing of the first mooring support structure,

the pitch bearing of the first mooring support structure is configured to allow the yoke of the first vessel support structure to pivot about a horizontal axis relative to the first mooring support structure,

the yoke head of the second vessel support structure is connected to the pitch bearing of the second mooring support structure,

the pitch bearing of the second mooring support structure is configured to allow the yoke of the second vessel support structure to pivot about a horizontal axis relative to the second mooring support structure, and

the system is configured to provide restoring forces between the first and second mooring support structures and the floating vessel in response to external environmental forces acting on the vessel.

20. A system for securing a vessel floating on a surface of a body of water in a stabilized position, comprising:

a first mooring support structure and a second mooring support structure, each fixed in place and comprising:

one or more extension arms, each having a first end and a second end, wherein the first end of the one or more extension arms is suspended from the mooring support structure;

a ballast tank connected to the second end of the one or more extension arms; and

a yoke having a first end and a second end, the first end connected to the ballast tank and the second end comprising a yoke head disposed thereon;

a first vessel support structure and a second vessel support structure, each disposed on the vessel, and each vessel support structure comprising a pitch bearing, wherein:

the yoke head of the first mooring support structure is connected to the pitch bearing of the first vessel support structure,

the pitch bearing of the first vessel support structure is configured to allow the yoke of the first mooring support structure to pivot about a horizontal axis relative to the first vessel support structure,

the yoke head of the second mooring support structure is connected to the pitch bearing of the second vessel support structure,

the pitch bearing of the second vessel support structure is configured to allow the yoke of the second mooring support structure to pivot about a horizontal axis relative to the second vessel support structure, and

the system is configured to provide restoring forces between the first and second mooring support structures and the floating vessel in response to external environmental forces acting on the vessel.

21. The system of claim 1, wherein each yoke is formed from one or more tubular members.

22. The system of claim 1, wherein:

the first vessel support structure is located on a port side or a starboard side of the vessel,

the second vessel support structure is located on a bow or a stern of the vessel between the port side and the starboard side of the vessel, and

the system restricts the vessel from rotating relative to a surface of the earth.

23. The system of claim 1, wherein:

the first vessel support structure is located on a port side or a starboard side of the vessel toward a bow of the vessel,

the second vessel support structure is located on the same side of the vessel as the first vessel support structure toward a stern of the vessel,

a distance between the first and second vessel support structures is (i) greater than a distance between the first vessel support structure and an end of the vessel at the bow and (ii) greater than a distance between the second vessel support structure and an end of the vessel at the stern, and

the system restricts the vessel from rotating relative to a surface of the earth.

24. The system of claim 1, wherein:

the first vessel support structure is located on a bow of the vessel between a port side and a starboard side of the vessel,

the second vessel support structure is located on a stern of the vessel between the port side and the starboard side of the vessel, and

the system restricts the vessel from rotating relative to a surface of the earth.

25. The system of claim 1, wherein:

the first vessel support structure is located on a port side of the vessel,

the second vessel support structure is located on a starboard side of the vessel, and

the system restricts the vessel from rotating relative to a surface of the earth.