CLAIMS

1. A system for mooring a vessel, comprising:

a mooring support structure comprising:

a base structure; and

a turntable disposed on the base structure, wherein the turntable is configured to at least partially rotate about the base structure;

a vessel support structure disposed on the vessel;

at least one extension arm suspended from the vessel support structure;

a ballast tank connected to the at least one extension arm, the ballast tank configured to move back and forth below the vessel support structure;

a uni-directional passive surge damping system disposed on the vessel, the uni-directional passive surge damping system comprising:

an elongated tension member connected to the ballast tank, ~~and~~ wherein the elongated tension member is configured to dampen a movement of the ballast tank by applying a tension to the ballast tank; and

a hydraulic cylinder, an accumulator, and a manifold block disposed between the hydraulic cylinder and the accumulator, wherein:

the hydraulic cylinder, the accumulator, and the manifold block are in fluid communication with one another,

the accumulator is configured to apply a pressure to the hydraulic cylinder,

when the pressure is applied to the hydraulic cylinder, the hydraulic cylinder is configured to apply a force to the elongated tension member,

when the force is applied to the elongated tension member, at least a portion of the force is transferred to the ballast tank as the tension applied by the elongated tension member to dampen the movement of the ballast tank,

the manifold block comprises a check valve and a pressure reducing fitting,

the manifold block is configured to restrict the flow of a fluid from the hydraulic cylinder into the accumulator such that the pressure in the hydraulic cylinder increases as a speed of the ballast tank increases in a direction away from the vessel, and

the increase in pressure in the hydraulic cylinder increases the force applied to the elongated tension member**;** and

a yoke extending from and connected at a first end to the ballast tank, wherein the yoke comprises a yoke head disposed on a second end thereof, and wherein the yoke head is configured to connect to the turntable.

2. The system of claim 1, wherein the uni-directional passive surge damping system is configured to increase the tension applied to the ballast tank by the elongated member as a speed of the ballast tank moving away from the vessel increases, and wherein the uni-directional passive surge damping system is configured to not increase the tension applied to the ballast tank by the elongated member as a speed of the ballast tank moving toward the vessel increases

3. The system of claim 1, wherein the uni-directional passive surge damping system further comprises a heat exchanger configured to remove heat generated by the uni-directional passive surge damping system when the uni-directional passive surge damping system dampens the movement of the ballast tank, and wherein the heat exchanger comprises a liquid cooled open loop heat exchanger, an air cooled closed loop heat exchanger, or a liquid cooled closed loop heat exchanger

4. The system of claim 1, wherein the uni-directional passive surge damping system further comprises a pulley, and wherein a portion of the elongated tension member is routed around a portion of the pulley.

5. The system of claim 1, wherein the elongated tension member comprises a cable or wire rope.

6. The system of claim 1, wherein the uni-directional passive surge damping system comprises a wire line tensioner or a N-Line tensioner.

7. The system of claim 1, wherein the uni-directional passive surge damping system is free of any active control system.

8. The system of claim 1, wherein

the manifold block is configured to allow fluid to flow from the accumulator into the hydraulic cylinder to apply [[a]] the force to the elongated tension member, wherein the force [[that]] is not dependent on a speed of the ballast tank as the ballast tank moves toward the vessel.

9. The system of claim 11, wherein the uni-directional passive surge damping system is configured to not increase the tension applied to the ballast tank by the elongated member as a speed of the ballast tank moving toward the vessel increases

10. The system of claim 1, wherein:

the manifold block is configured to allow fluid to flow from the accumulator into the hydraulic cylinder to apply [[a]] the force to the elongated tension member, wherein the force [[that]] is not dependent on a speed of the ballast tank as the ballast tank moves toward the vessel,

the uni-directional passive surge damping system further comprises a pulley, wherein a portion of the elongated tension member is routed over a portion of the pulley,

the elongated tension member comprises a cable or wire rope, and

a first end of the elongated tension member is connected to the ballas tank and a second end of the elongated tension member is connected to the vessel.

11. The system of claim 1, wherein the turntable comprises a yoke head connector disposed thereon, wherein at least one of the yoke head and the yoke head connector is in communication with at least one actuator, and wherein the at least one actuator is configured to lock the yoke head and the yoke head connector in mating engagement and configured to unlock and allow the engaged yoke head and yoke head connector to disengage from one another.

12. A process for damping a motion of a floating vessel moored to a mooring support structure at sea, wherein the floating vessel comprises:

a vessel support structure disposed on the vessel;

at least one extension arm suspended from the vessel support structure;

a ballast tank connected to the at least one extension arm, the ballast tank configured to move back and forth below the vessel support structure;

a uni-directional passive surge damping system disposed on the vessel, wherein the uni-directional passive surge damping system comprises:

an elongated tension member configured to be connected to the ballast tank, and

a hydraulic cylinder, a manifold block, and an accumulator in fluid communication with one another, wherein the manifold block comprises a check valve and a pressure reducing fitting; and

a yoke extending from and connected at a first end to the ballast tank, wherein the yoke comprises a yoke head disposed on a second end thereof, and wherein the yoke head is connected to a turntable disposed on the mooring support structure; and wherein, the mooring support structure comprises a base structure, wherein the turntable is disposed on the base structure, and wherein the turntable is configured to at least partially rotate about the base structure; the process comprising:

connecting the elongated tension member to the ballast tank; and

damping a movement of the ballast tank by applying a tension to the ballast tank with the elongated tension member as the ballast tank moves away from the vessel, wherein damping the movement of the ballast tank comprises:

applying a pressure to the hydraulic cylinder by restricting a flow of a fluid from the hydraulic cylinder into the accumulator, wherein:

the manifold restricts the flow of the fluid,

the fluid flows through the pressure reducing fitting when the ballast tank moves away from the vessel,

the fluid flows through the check valve when the ballast tank moves toward the vessel,

when the pressure is applied to the hydraulic cylinder, the hydraulic cylinder applies a force to the elongated tension member, and

at least a portion of the force is transferred to the ballast tank as the tension applied by the elongated tension member

13. The process of claim 12, wherein the tension applied to the ballast tank by the elongated member increases as a speed of the ballast tank moving away from the vessel increases, and wherein the tension applied by the elongated member to the ballast tank when the ballast tank moves toward the vessel does not increase as a speed of the ballast tank moving toward the vessel increases.

14. The process of claim 12, further comprising removing heat generated by the uni-directional passive surge damping system with a heat exchanger when the uni-directional passive surge damping system dampens the movement of the ballast tank, wherein the heat exchanger comprises a liquid cooled open loop heat exchanger, an air cooled closed loop heat exchanger, or a liquid cooled closed loop heat exchanger

15. The process of claim 12, wherein the turntable comprises a yoke head connector disposed thereon, wherein connecting the yoke head to the turntable comprises actuating at least one actuator in communication with the yoke head or the yoke head connector to lock the yoke head and the yoke head connector in mating engagement