Claims

1. A turret mooring system for a tidal turbine assembly, the turret mooring system comprising:

a turret having:

a shaft for mounting to the tidal turbine assembly and for allowing relative motion between the turret and the tidal turbine assembly about a rotational axis; and

a chain table secured to a lower end of the shaft;

an upstream mooring line for coupling a single upstream anchoring point on a water bed to an upstream portion of the chain table; and

a downstream mooring line for coupling a single downstream anchoring point on the water bed to a downstream portion of the chain table; wherein

the upstream mooring line is a bifurcated mooring line for coupling to two spaced apart upstream attachment points on the upstream portion of the chain table; and/or wherein

the downstream mooring line is a bifurcated mooring line for coupling to two spaced apart downstream attachment points on the downstream portion of the chain table.

2. The turret mooring system of claim 1, wherein the spaced apart upstream and/or downstream attachment points on the chain table are spaced apart by at least 1 metre.

3. The turret mooring system of claim 1 or claim 2, wherein the upstream mooring line has a first portion for coupling the upstream anchoring point on the sea bed to a bridle and a second portion for coupling the bridle to two upstream attachment points on the upstream portion of the chain table; and/or wherein

the downstream mooring line has a first portion for coupling the downstream anchoring point on the sea bed to a bridle and a second portion for coupling the bridle to two downstream attachment points on the downstream portion of the chain table.

4. The turret mooring system of claim 3 wherein the first and second portions of the upstream or downstream mooring line are made from different materials.

5. The turret mooring system of claim 4, wherein the first portion of the upstream or downstream mooring line is a chain and/or the second portion of the upstream or downstream mooring line is a pair of low mass synthetic cables.

6. The turret mooring system of any one of the preceding claims, wherein the turret is arranged to provide an upward force when the chain table is submerged in water.

7. The turret mooring system of claim 6, wherein the upward force is provided by an element which is buoyant in water.

8. The turret mooring system of claim 7, wherein the element is housed in the chain table.

9. The turret mooring system of claim 7 or claim 8, wherein the element has a variable buoyancy.

10. The turret mooring system of claim 9, wherein the buoyancy of the element is variable by pumping air through the shaft.

11. The turret mooring system of any one of claims 6 to 10, wherein the upward force is provided by a hydrodynamic fairing on the chain table.

12. The turret mooring system of claim 11, wherein the hydrodynamic fairing is bi-directional.

13. The turret mooring system of claim 11 or claim 12, wherein the hydrodynamic fairing is symmetric in an upstream-downstream direction.

14. The turret mooring system of any one of claims 11 to 13, wherein the hydrodynamic fairing is shaped to counteract expected pitching moments in the tidal turbine assembly due to drag on the turbines.

~~15. A turret mooring system for a tidal turbine assembly, the turret mooring system comprising:~~

~~a turret having a shaft for mounting to the tidal turbine assembly and for allowing relative motion between the turret and the tidal turbine assembly about a rotational axis and a chain table secured to a lower end of the shaft; wherein~~

~~the turret is arranged to provide an upward force when the chain table is submerged in water.~~

~~16. The turret mooring system of claim 15, wherein the upward force is provided by an element which is buoyant in water.~~

~~17. The turret mooring system of claim 16, wherein the element is housed in the chain table.~~

~~18. The turret mooring system of claim 16 or claim 17, wherein the element has a variable buoyancy.~~

~~19. The turret mooring system of claim 18, wherein the buoyancy of the element is variable by pumping air through the shaft.~~

~~20. The turret mooring system of any one of claims 15 to 19, wherein the upward force is provided by a hydrodynamic fairing on the chain table.~~

~~21. The turret mooring system of claim 20, wherein the hydrodynamic fairing is bi-directional.~~

~~22. The turret mooring system of claim 20 or claim 21, wherein the hydrodynamic fairing is symmetric in an upstream-downstream direction.~~

~~23. The turret mooring system of any one of claims 20 to 22, wherein the hydrodynamic fairing is shaped to counteract expected pitching moments in the tidal turbine assembly due to drag on the turbines.~~

~~24. The turret mooring system of any one of claims 15 to 23, wherein an upstream portion of the chain table is configured to couple to a single upstream anchoring point on a water bed via an upstream mooring line and wherein a downstream portion of the chain table is configured to couple to a single downstream anchoring point on a water bed via a downstream mooring line.~~

25. The turret mooring system of claim 24, further including the upstream and downstream mooring lines.

26. The turret mooring system of claim 24 or claim 25, wherein the upstream mooring line is a bifurcated mooring line for coupling to two spaced apart upstream attachment points on the upstream portion of the chain table; and/or wherein

the downstream mooring line is a bifurcated mooring line for coupling to two spaced apart downstream attachment points on the downstream portion of the chain table.

27. The turret mooring system of claim 26, wherein the spaced apart upstream and/or downstream attachment points on the chain table are spaced apart by at least 1 metre.

28. The turret mooring system of any one of claims 25 to 27, wherein the upstream mooring line has a first portion for coupling the upstream anchoring point on the sea bed to a bridle and a second portion for coupling the bridle to two upstream attachment points on the upstream portion of the chain table; and/or wherein

the downstream mooring line has a first portion for coupling the downstream anchoring point on the sea bed to a bridle and a second portion for coupling the bridle to two downstream attachment points on the downstream portion of the chain table.

29. The turret mooring system of claim 28 wherein the first and second portions of the upstream or downstream mooring line are made from different materials.

30. The turret mooring system of claim 29, wherein the first portion of the upstream or downstream mooring line is a chain and/or the second portion of the upstream or downstream mooring line is a pair of low mass synthetic cables.

31. The turret mooring system of any one of the preceding claims, wherein the shaft includes an upper radial bearing and a lower radial bearing for engaging with the tidal turbine assembly.

32. The turret mooring system of any preceding claim, wherein the turret is mounted into the tidal turbine assembly.

~~33. The turret mooring system of claim 32 wherein the turret is slidable in a vertical direction relative to the tidal turbine assembly.~~

~~34. The turret mooring system of any preceding claim, wherein the shaft is a cluster of pipes.~~

~~35~~15. A method of mooring a tidal turbine assembly to a water bed using the turret mooring system of any preceding claim, the method comprising:

(i) transporting the tidal turbine assembly to an installation site;

(ii) coupling an upstream portion of the chain table of the turret to the water bed at a single upstream anchoring point and coupling a downstream portion of the chain table of the turret to the water bed at a single downstream anchoring point; and

(iii) securing the turret into the tidal turbine assembly.

~~36~~16. The method of claim ~~35~~15, wherein step (iii) is performed prior to steps (i) and (ii), and step (iii) is performed in a dock or on land.

~~37~~17. The method of claim ~~36~~16, wherein once step (iii) has been completed, the turret is slidable in a vertical direction relative to the tidal turbine assembly between a raised position and a lowered position such that the draft of the tidal turbine assembly is greater when the turret is in the lowered position than when it is in the raised position.

~~38~~18. The method of claim ~~37~~17, wherein the turret is in the raised position during step (i).

~~39~~19. The method of any one of claims ~~35–~~15 to ~~38~~18, wherein the turret is arranged to provide an upward force when the chain table is submerged in water and the turret is slidable in a vertical direction; and wherein

the vertical position of the turret is adjusted prior to or during step (i) to control the pitch of the tidal turbine assembly during transport.

~~40~~20. The method of any one of claims ~~35–~~15 to ~~39~~19, wherein the tidal turbine assembly includes one or more turbines which are configurable in a deployed arrangement in which they are below the expected water line, and also in a raised

arrangement in which the turbines are entirely above the expected water line; and wherein the turbines are further configured in the raised arrangement during step (i).