[0006] U.S. Patent No. 8,197,293, assigned to Bluewater Energy Services B.V., discloses initially installing a secondary bearing assembly in place and loading the secondary bearing assembly when the primary bearing assembly no longer functions. One drawback to this is that including two bearing assemblies (one as a spare) is cost prohibitive and adversely affects capital expense.

[0007] It would be desirable to be able to replace or repair a damaged turret three-row roller bearing assembly in situ. It would also be desirable to be able to replace or repair a damaged turret three-row roller bearing assembly while the vessel stays on station. It would be desirable to be able to remove the large vertical load from the existing bearing support row and allow the vessel to stay on station. It would be desirable to be able to provide a new vertical load path in situ while allowing the vessel to weather vane about the turret.

SUMMARY OF THE INVENTION

[0007a] According to a first aspect of the present invention, there is provided the following: In a three row, roller bearing assembly rotatively coupling a vessel to a turret, the three row, roller bearing assembly having a support row assembly, a radial row assembly and an uplift row assembly disposed between an inner ring connected to the turret and outer upper and lower rings connected to the vessel, a method for in situ remediation of the damaged support row assembly comprising the steps of:

removing the outer upper ring from engagement with the outer lower ring;

installing a circumferential support ring on the outer lower ring;

installing at least a portion of a remedial support row assembly on the support ring;

positioning a circumferential reaction ring above the support ring;

connecting the reaction ring to the inner ring secured to the turret;

axially displacing the inner ring and turret relative to the outer lower ring and transferring the turret axial loading to the remedial support row assembly between the support ring and the reaction ring; and

securing the inner ring and turret in the axially displaced position.

[0007b] According to a second aspect of the present invention, there is provided the following: A remedial support bearing assembly for a damaged support bearing positioned between a turret and a turret supporting structure of a floating vessel and providing vertical load transfer of the turret to the floating vessel, the remedial support bearing assembly comprising:

a circumferential support ring arranged and designed to be connected to the turret supporting structure;

a circumferential reaction ring arranged and designed to be positioned above the support ring;

a remedial support bearing arranged and designed to be positioned between and separating the support ring and the reaction ring; and

a plurality of strongback assemblies arranged and designed to abut a top surface of the reaction ring and be connected to the turret.

[0008] The invention provides a repair to a turret bearing assembly with damaged support row rollers and/or support race. The repair can be performed and assembled in-situ offshore and transfers the load off the main turret bearing's support race and onto a new replacement race in a single lift sequence, thereby simplifying the operation and minimizing the timeframe to perform the load transfer. Additionally, the arrangement removes the need to uninstall the vessel from its offshore location to perform remedial work on the damaged bearing assembly, thereby relieving the vessel's owner of considerable risk and cost implications.

[0009] The invention has the goal of removing axial load from an in place damaged three-row roller bearing assembly and allow the vessel to continue to weather vane in either a free-state or with assistance. The invention removes load from the existing bearing support row. Radial load

We claim:

1. In a three row, roller bearing assembly rotatively coupling a vessel to a turret, the three row, roller bearing assembly having a support row assembly, a radial row assembly and an uplift row assembly disposed between an inner ring connected to the turret and outer upper and lower rings connected to the vessel, a method for in situ remediation of the damaged support row assembly comprising the steps of:

removing the outer upper ring from engagement with the outer lower ring;

installing a circumferential support ring on the outer lower ring;

installing at least a portion of a remedial support row assembly on the support ring;

positioning a circumferential reaction ring above the support ring;

connecting the reaction ring to the inner ring secured to the turret;

axially displacing the inner ring and turret relative to the outer lower ring and transferring the turret axial loading to the remedial support row assembly between the support ring and the reaction ring; and

securing the inner ring and turret in the axially displaced position.

2. The method of claim 1, wherein the step of installing a circumferential support ring comprises installing a plurality of support ring segments in abutting relation.

3. The method of claim 1, wherein the step of positioning a circumferential reaction ring above the support ring comprises joining a plurality of reaction ring segments to one another while positioned above the support ring.

4. The method of claim 1, wherein the step of connecting the reaction ring to the inner ring secured to the turret comprises:

circumferentially positioning a plurality of strongback assemblies on top of the reaction ring; and

connecting each strongback assembly to the inner ring with a plurality of puller bars.

5. The method of claim 4, wherein the step of connecting each strongback assembly to the inner ring with a plurality of puller bars comprises connecting a first end of each puller bar to a protruding end of an inner ring stud bolt and having a second end of each puller bar passing through a hole in the strongback assembly.

6. The method of claim 5, wherein the step of axially displacing the inner ring and turret relative to the outer lower ring and transferring the turret axial loading comprises:

installing a hydraulic jack at the location of each strongback assembly; and

simultaneously energizing each of the hydraulic jacks to lift the inner ring and turret relative to the outer lower ring and immediately transferring the turret axial loading from the damaged support bearing to the remedial support row assembly.

7. The method of claim 6, wherein the step of securing the inner ring and turret in the axially displaced position comprises adjusting a nut on the second end of each puller bar to a seated position against the strongback assembly.

8. The method of claim 4, wherein the step of axially displacing the inner ring and turret relative to the outer lower ring and transferring the turret axial loading comprises:

installing a hydraulic jack at the location of each strongback assembly; and

simultaneously energizing each of the hydraulic jacks to lift the inner ring and turret relative to the outer lower ring and immediately transferring the turret axial loading from the damaged support bearing to the remedial support row assembly.

9. A remedial support bearing assembly for a damaged support bearing positioned between a turret and a turret supporting structure of a floating vessel and providing vertical load transfer of the turret to the floating vessel, the remedial support bearing assembly comprising:

a circumferential support ring arranged and designed to be connected to the turret supporting structure;

a circumferential reaction ring arranged and designed to be positioned above the support ring;

a remedial support bearing arranged and designed to be positioned between and separating the support ring and the reaction ring; and

a plurality of strongback assemblies arranged and designed to abut a top surface of the reaction ring and be connected to the turret.

10. The remedial support bearing assembly of claim 9, wherein the circumferential support ring comprises a plurality of support ring segments arranged and designed to be in abutting relation.

11. The remedial support bearing assembly of claim 10, wherein the plurality of support ring segments are arranged and designed to be fastened to the turret supporting structure.

12. The remedial support bearing assembly of claim 9, wherein the circumferential reaction ring comprises a plurality of reaction ring segments.

13. The remedial support bearing assembly of claim 9, wherein the plurality of strongback assemblies are arranged and designed to be circumferentially positioned on the reaction ring.

14. The remedial support bearing assembly of claim 13, further comprising a plurality of puller bars, wherein the plurality of strongback assemblies are arranged and designed to be connected to the turret with the plurality of puller bars.

15. The remedial support bearing assembly of claim 14, wherein each puller bar comprises a first end arranged and designed to be connected to a protruding end of an existing inner ring stud bolt and has a second end arranged and designed to pass through a hole in the strongback assembly.