CLAIMS

What is claimed is:

1. A gas turbine engine comprising:

a shaft defining an axis of rotation;

a turbine section comprising:

an inner rotor directly driving the shaft, the inner rotor including an inner set of blades; and

an outer rotor having an outer set of blades interspersed with the inner set of blades, the outer rotor configured to rotate in an opposite direction about the axis of rotation from the inner rotor; and

a gear system coupling the outer rotor to the shaft and configured to rotate the inner set of blades at a lower speed than the outer set of blades.

2. The gas turbine engine according to claim 1, wherein the gear system is mounted to a turbine exhaust case.

3. The gas turbine engine according to claim 2, wherein the gear system includes a sun gear engaged to the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

4. The gas turbine engine according to claim 3, wherein the sun gear is fixed for rotation with an aft end of the outer rotor.

5. The gas turbine engine according to claim 3, wherein the star gears are supported within a carrier that is fixed to the turbine exhaust case.

6. The gas turbine engine according to claim 3, wherein an aft end of the shaft includes a portion that extends radially outward from the axis to be coupled to the ring gear.

7. The gas turbine engine according to claim 2, including a first bearing supporting a fore end of the outer rotor for rotation relative to a mid-turbine frame structure and a second bearing supporting an aft end of the outer rotor for rotation relative to the shaft.

8. The gas turbine engine according to claim 7, including a third bearing supporting the shaft for rotation relative to the mid-turbine frame structure.

9. The gas turbine engine according to claim 8, wherein the first and third bearings are generally radially aligned with each other relative to the axis of rotation.

10. The gas turbine engine according to claim 2, including a low pressure turbine static case having an aft end connected to the turbine exhaust case and a fore end connected to a mid-turbine frame case.

11. The gas turbine engine according to claim 1, wherein a fore end of the shaft is associated with a counter-rotating low pressure compressor.

12. A gas turbine engine comprising:

a core air flowpath;

a shaft supporting a compressor section and a turbine section arranged within the core flowpath; and

wherein the turbine section includes a counter-rotating low pressure turbine comprising

an inner rotor directly driving the shaft, the inner rotor including an inner set of blades,

an outer rotor having an outer set of blades interspersed with the inner set of blades, the outer rotor configured to rotate in an opposite direction about the axis of rotation from the inner rotor, and

a gear system coupling the outer rotor to the shaft and configured to rotate the inner set of blades at a lower speed than the outer set of blades.

13. The gas turbine engine according to claim 12, wherein the compressor section includes a high pressure compressor section that has a pressure ratio of approximately 23:1.

14. The gas turbine engine according to claim 12, wherein the compressor section includes a counter-rotating low pressure compressor driven by the shaft.

15. The gas turbine engine according to claim 12, wherein the gear system is mounted to a turbine exhaust case.

16. The gas turbine engine according to claim 15, wherein the gear system includes a sun gear engaged to the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

17. The gas turbine engine according to claim 16, wherein the sun gear is fixed for rotation with an aft end of the outer rotor, the star gears are supported within a carrier that is fixed to the turbine exhaust case, and an aft end of the shaft includes a portion that extends radially outward from the axis to be coupled to the ring gear.

18. The gas turbine engine according to claim 12, including a first bearing supporting a fore end of the outer rotor for rotation relative to a mid-turbine frame structure, a second bearing supporting an aft end of the outer rotor for rotation relative to the shaft, and a third bearing supporting the shaft for rotation relative to the mid-turbine frame structure.

19. The gas turbine engine according to claim 18, wherein the first and third bearings are generally radially aligned with each other relative to the axis of rotation.

20. The gas turbine engine according to claim 18, wherein the first and third bearings are roller bearings and the second bearing is a ball bearing.

CLAIMS

1. A gas turbine engine comprising:

a shaft defining an axis of rotation;

a turbine section comprising:

an inner rotor directly driving the shaft, the inner rotor including an inner set of blades; and

an outer rotor having an outer set of blades interspersed with the inner set of blades, the outer rotor configured to rotate in an opposite direction about the axis of rotation from the inner rotor; and

a gear system coupling the outer rotor to the shaft and configured to rotate the inner set of blades at a lower speed than the outer set of blades.

2. The gas turbine engine according to claim 1, wherein the gear system is mounted to a turbine exhaust case.

3. The gas turbine engine according to claim 2, wherein the gear system includes a sun gear engaged to the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

4. The gas turbine engine according to claim 3, wherein the sun gear is fixed for rotation with an aft end of the outer rotor.

5. The gas turbine engine according to claim 3, wherein the star gears are supported within a carrier that is fixed to the turbine exhaust case.

6. The gas turbine engine according to claim 3, wherein an aft end of the shaft includes a portion that extends radially outward from the axis to be coupled to the ring gear.

7. The gas turbine engine according to claim 2, including a first bearing supporting a fore end of the outer rotor for rotation relative to a mid-turbine frame structure and a second bearing supporting an aft end of the outer rotor for rotation relative to the shaft.

8. The gas turbine engine according to claim 7, including a third bearing supporting the shaft for rotation relative to the mid-turbine frame structure.

9. The gas turbine engine according to claim 8, wherein the first and third bearings are generally radially aligned with each other relative to the axis of rotation.

10. The gas turbine engine according to claim 2, including a low pressure turbine static case having an aft end connected to the turbine exhaust case and a fore end connected to a mid-turbine frame case.

11. The gas turbine engine according to claim 1, wherein a fore end of the shaft is associated with a counter-rotating low pressure compressor.

12. A gas turbine engine comprising:

a core air flowpath;

a shaft supporting a compressor section and a turbine section arranged within the core flowpath; and

wherein the turbine section includes a counter-rotating low pressure turbine comprising

an inner rotor directly driving the shaft, the inner rotor including an inner set of blades,

an outer rotor having an outer set of blades interspersed with the inner set of blades, the outer rotor configured to rotate in an opposite direction about the axis of rotation from the inner rotor, and

a gear system coupling the outer rotor to the shaft and configured to rotate the inner set of blades at a lower speed than the outer set of blades.

13. The gas turbine engine according to claim 12, wherein the compressor section includes a high pressure compressor section that has a pressure ratio of approximately 23:1.

14. The gas turbine engine according to claim 12, wherein the compressor section includes a counter-rotating low pressure compressor driven by the shaft.

15. The gas turbine engine according to claim 12, wherein the gear system is mounted to a turbine exhaust case.

16. The gas turbine engine according to claim 15, wherein the gear system includes a sun gear engaged to the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

17. The gas turbine engine according to claim 16, wherein the sun gear is fixed for rotation with an aft end of the outer rotor, the star gears are supported within a carrier that is fixed to the turbine exhaust case, and an aft end of the shaft includes a portion that extends radially outward from the axis to be coupled to the ring gear.

18. The gas turbine engine according to claim 12, including a first bearing supporting a fore end of the outer rotor for rotation relative to a mid-turbine frame structure, a second bearing supporting an aft end of the outer rotor for rotation relative to the shaft, and a third bearing supporting the shaft for rotation relative to the mid-turbine frame structure.

19. The gas turbine engine according to claim 18, wherein the first and third bearings are generally radially aligned with each other relative to the axis of rotation.

20. The gas turbine engine according to claim 18, wherein the first and third bearings are roller bearings and the second bearing is a ball bearing.

21. The gas turbine engine according to claim 12, wherein the gear system is positioned downstream of the inner and outer sets of blades.

22. The gas turbine engine according to claim 12, wherein the gear system includes a sun gear directly driven by the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears, the ring gear directly driving the shaft.

23. The gas turbine engine according to claim 1, wherein the gear system is positioned downstream of the inner and outer sets of blades.

24. The gas turbine engine according to claim 1, wherein the gear system includes a sun gear directly driven by the outer rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears, the ring gear directly driving the shaft.