Claims

1. A gas turbine engine comprising:

a shaft defining an axis of rotation;

a turbine section comprising:

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

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

a first bearing supporting a fore end of the inner rotor;

a second bearing supporting an aft end of the inner rotor, wherein the first and second bearings are mounted on the shaft; and

a gear system coupling the inner rotor to the shaft and configured to rotate the inner set of blades at a faster 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 inner 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 inner 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 1, including a third bearing supporting the shaft for rotation relative to a mid-turbine frame structure.

8. The gas turbine engine according to claim 7, wherein the first, second, and third bearings are axially aligned with each other and spaced apart from each other parallel to axis of rotation with the third bearing being located forward of the first bearing.

9. 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.

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

11. A gas turbine engine comprising:

a core air flowpath;

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

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

an outer rotor directly driving the shaft, the outer rotor including an outer set of blades, an inner rotor having an inner set of blades interspersed with the outer set of blades, the inner rotor configured to rotate in an opposite direction about the axis of rotation from the outer rotor, a first bearing supporting a fore end of the inner rotor, a second bearing supporting an aft end of the inner rotor wherein the first and second bearings are mounted on the shaft, and a gear system coupling the inner rotor to the shaft and configured to rotate the inner set of blades at a faster speed than the outer set of blades.

12. A gas turbine engine comprising:

a core air flowpath;

a shaft supporting a compressor section and a turbine section arranged within the core flow path wherein the compressor section includes a high pressure compressor section that has a pressure ratio of approximately 23:1; and

wherein the turbine section includes a counter-rotating low pressure turbine comprising an outer rotor directly driving the shaft, the outer rotor including an outer set of blades, an inner rotor having an inner set of blades interspersed with the outer set of blades,

the inner rotor configured to rotate in an opposite direction about the axis of rotation from the outer rotor, and

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

13. The gas turbine engine according to claim 11, wherein the compressor section includes a counter-rotating low pressure compressor driven by the shaft.

14. The gas turbine engine according to claim 11, wherein the gear system is mounted to a turbine exhaust case.

15. The gas turbine engine according to claim 14, wherein the gear system includes a sun gear engaged to the inner rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

16. The gas turbine engine according to claim 15, wherein the sun gear is fixed for rotation with an aft end of the inner 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 away from the axis of rotation to be coupled to the ring gear.

17. The gas turbine engine according to claim 11, including a third bearing supporting the shaft for rotation relative to a mid-turbine frame structure.

18. The gas turbine engine according to claim 17, wherein the first, second, and third bearings are axially aligned with each other and spaced apart from each other parallel to the axis of rotation with the third bearing being located upstream from the first bearing.

19. The gas turbine engine according to claim 17, wherein the first and third bearings are roller bearings and the second bearing is a ball bearing.

20. The gas turbine engine according to claim 11, wherein the first and second bearings are axially aligned with each other and are positioned directly between the shaft and the inner rotor.

21. The gas turbine engine according to claim 1, wherein the first and second bearings are axially aligned with each other and are positioned directly between the shaft and the inner rotor.

22. A gas turbine engine comprising:

at least one shaft defining an axis of rotation;

a compressor section including a counter-rotating low pressure compressor driven by the at least one shaft and a high pressure compressor section that has a pressure ratio of approximately 23:1;

a turbine section comprising

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

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

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

23. The gas turbine engine according to claim 22, including a first bearing supporting a fore end of the inner rotor and a second bearing supporting an aft end of the inner rotor, wherein the first and second bearings are positioned directly between the shaft and the inner rotor.

Claims

1. A gas turbine engine comprising:

a shaft defining an axis of rotation;

a turbine section comprising:

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

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

a first bearing supporting a fore end of the inner rotor;

a second bearing supporting an aft end of the inner rotor, wherein the first and second bearings are mounted on the shaft; and

a gear system coupling the inner rotor to the shaft and configured to rotate the inner set of blades at a faster 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 inner 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 inner 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 1, including a third bearing supporting the shaft for rotation relative to a mid-turbine frame structure.

8. The gas turbine engine according to claim 7, wherein the first, second, and third bearings are axially aligned with each other and spaced apart from each other parallel to axis of rotation with the third bearing being located forward of the first bearing.

9. 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.

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

11. A gas turbine engine comprising:

a core air flowpath;

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

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

an outer rotor directly driving the shaft, the outer rotor including an outer set of blades, an inner rotor having an inner set of blades interspersed with the outer set of blades, the inner rotor configured to rotate in an opposite direction about the axis of rotation from the outer rotor, a first bearing supporting a fore end of the inner rotor, a second bearing supporting an aft end of the inner rotor wherein the first and second bearings are mounted on the shaft, and a gear system coupling the inner rotor to the shaft and configured to rotate the inner set of blades at a faster speed than the outer set of blades.

12. The gas turbine engine according to claim 11, wherein the compressor section includes a counter-rotating low pressure compressor driven by the shaft.

13. The gas turbine engine according to claim 11, wherein the gear system is mounted to a turbine exhaust case.

14. The gas turbine engine according to claim 13, wherein the gear system includes a sun gear engaged to the inner rotor, a plurality of star gears in meshing engagement with the sun gear, and a ring gear in meshing engagement with the star gears.

15. The gas turbine engine according to claim 14, wherein the sun gear is fixed for rotation with an aft end of the inner 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 away from the axis of rotation to be coupled to the ring gear.

16. The gas turbine engine according to claim 11, including a third bearing supporting the shaft for rotation relative to a mid-turbine frame structure.

17. The gas turbine engine according to claim 16, wherein the first, second, and third bearings are axially aligned with each other and spaced apart from each other parallel to the axis of rotation with the third bearing being located upstream from the first bearing.

18. The gas turbine engine according to claim 16, wherein the first and third bearings are roller bearings and the second bearing is a ball bearing.

19. The gas turbine engine according to claim 11, wherein the first and second bearings are axially aligned with each other and are positioned directly between the shaft and the inner rotor.

20. The gas turbine engine according to claim 1, wherein the first and second bearings are axially aligned with each other and are positioned directly between the shaft and the inner rotor.