CLAIMS

What is claimed is:

1. A gas turbine engine comprising:

a compressor section;

a combustor in fluid communication with the compressor section;

a turbine section in fluid communication with the combustor, the turbine section including a fan drive turbine and a second turbine, the fan drive turbine including a plurality of turbine rotors;

a fan including a plurality of blades rotatable about an axis and a ratio between the number of fan blades and the number of fan drive turbine rotors is between about 2.5 and about 8.5; and

a speed change system driven by the fan drive turbine for rotating the fan about the axis;

wherein the fan drive turbine includes a first aft rotor attached to a first shaft and the second turbine includes a second aft rotor attached to a second shaft and an annular space is defined between the first shaft and the second shaft,

wherein a first bearing assembly is disposed axially aft of a first connection between the first aft rotor and the first shaft, and a second bearing assembly is disposed within the annular space defined between the first shaft and the second shaft.

2. The engine as recited in claim 1, wherein the first bearing assembly and the second bearing assembly comprise roller bearings.

3. The engine as recited in claim 1, wherein the compressor section comprises a first compressor driven by the fan drive turbine through the first shaft and a second compressor section driven by the second turbine through the second shaft, wherein the first bearing supports an aft portion of the first shaft and the second bearing supports an aft portion of the second shaft on the first shaft.

4. The engine as recited in claim 3, wherein a forward portion of each of the first and second shafts are supported by a thrust bearing assembly.

5. The engine as recited in claim 1, wherein the fan drive turbine has a first exit area at a first exit point and rotates at a first speed, the second turbine section has a second exit area at a second exit point and rotates at a second speed, which is faster than the first speed, wherein a first performance quantity is defined as the product of the first speed squared and the first area, a second performance quantity is defined as the product of the second speed squared and the second area, and a performance ratio of the first performance quantity to the second performance quantity is between about 0.5 and about 1.5.

6. The engine as recited in claim 5, wherein the performance ratio is above or equal to about 0.8.

7. The engine as recited in claim 5, wherein the first performance quantity is above or equal to about 4.

8. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan and the fan drive turbine both rotate in a first direction about the axis and the second turbine section rotates in a second direction opposite the first direction.

9. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan, the fan drive turbine section, and the second turbine section all rotate in a first direction about the axis.

10. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan and the second turbine section both rotate in a first direction about the axis and the fan drive turbine rotates in a second direction opposite the first direction.

11. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan is rotatable in a first direction and the fan drive turbine and the second turbine section rotates in a second direction opposite the first direction about the axis.

12. The engine as recited in claim 1, wherein the speed change system comprises a gear reduction having a gear ratio greater than about 2.3.

13. The engine as recited in claim 1, wherein the fan delivers a portion of air into a bypass duct, and a bypass ratio being defined as the portion of air delivered into the bypass duct divided by the amount of air delivered into the compressor section, with the bypass ratio being greater than about 6.0.

14. The engine as recited in claim 9, wherein the bypass ratio is greater than about 10.0.

15. The engine as recited in claim 1, wherein a fan pressure ratio across the fan is less than about 1.5.

16. The engine as recited in claim 1, wherein the fan has 26 or fewer blades.

17. The engine as recited in claim 1, wherein said first turbine section has between about 3 and 6 stages.

18. The engine as recited in claim 1, wherein a pressure ratio across the first turbine section is greater than about 5:1.

19. The engine as recited in claim 1, including a power density greater than about 1.5 lbf/in^3 and less than or equal to about 5.5 lbf/in^3.

20. The engine as recited in claim 1, wherein the second turbine includes at least two stages and performs at a first pressure ratio and the fan drive turbine includes more than two stages and performs at a second pressure ratio less than the first pressure ratio.

CLAIMS

What is claimed is:

1. A gas turbine engine comprising:

a compressor section;

a combustor in fluid communication with the compressor section;

a turbine section in fluid communication with the combustor, the turbine section including a fan drive turbine and a second turbine, the fan drive turbine including a plurality of turbine rotors;

a fan including a plurality of blades rotatable about an axis and a ratio between the number of fan blades and the number of fan drive turbine rotors is between about 2.5 and about 8.5; and

a speed change system driven by the fan drive turbine for rotating the fan about the axis;

wherein the fan drive turbine includes a first aft rotor attached to a first shaft and the second turbine includes a second aft rotor attached to a second shaft and an annular space is defined between the first shaft and the second shaft,

wherein the compressor section comprises a first compressor driven by the fan drive turbine through the first shaft and a second compressor section driven by the second turbine through the second shaft and the first compressor section rotates at a speed the same as the speed of the fan drive turbine,

wherein a first bearing assembly is disposed axially aft of a first connection between the first aft rotor and the first shaft, and a second bearing assembly is disposed within the annular space defined between the first shaft and the second shaft.

2. The engine as recited in claim 1, wherein the first bearing assembly and the second bearing assembly comprise roller bearings.

3. The engine as recited in claim 1, , wherein the first bearing supports an aft portion of the first shaft and the second bearing supports an aft portion of the second shaft on the first shaft.

4. The engine as recited in claim 3, wherein a forward portion of each of the first and second shafts are supported by a thrust bearing assembly.

5. The engine as recited in claim 1, wherein the fan drive turbine has a first exit area at a first exit point and rotates at a first speed, the second turbine section has a second exit area at a second exit point and rotates at a second speed, which is faster than the first speed, wherein a first performance quantity is defined as the product of the first speed squared and the first area, a second performance quantity is defined as the product of the second speed squared and the second area, and a performance ratio of the first performance quantity to the second performance quantity is between about 0.5 and about 1.5.

6. The engine as recited in claim 5, wherein the performance ratio is above or equal to about 0.8.

7. The engine as recited in claim 5, wherein the first performance quantity is above or equal to about 4.

8. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan and the fan drive turbine both rotate in a first direction about the axis and the second turbine section rotates in a second direction opposite the first direction.

9. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan, the fan drive turbine section, and the second turbine section all rotate in a first direction about the axis.

10. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan and the second turbine section both rotate in a first direction about the axis and the fan drive turbine rotates in a second direction opposite the first direction.

11. The engine as recited in claim 1, wherein the speed change system comprises a gearbox, and wherein the fan is rotatable in a first direction and the fan drive turbine, and the second turbine section rotates in a second direction opposite the first direction about the axis.

12. The engine as recited in claim 1, wherein the speed change system comprises a gear reduction having a gear ratio greater than about 2.3.

13. The engine as recited in claim 1, wherein the fan delivers a portion of air into a bypass duct, and a bypass ratio being defined as the portion of air delivered into the bypass duct divided by the amount of air delivered into the compressor section, with the bypass ratio being greater than about 6.0.

14. The engine as recited in claim 9, wherein the bypass ratio is greater than about 10.0.

15. The engine as recited in claim 1, wherein a fan pressure ratio across the fan is less than about 1.5.

16. The engine as recited in claim 1, wherein the fan has 26 or fewer blades.

17. The engine as recited in claim 1, wherein said first turbine section has between about 3 and 6 stages.

18. The engine as recited in claim 1, wherein a pressure ratio across the first turbine section is greater than about 5:1.

19. The engine as recited in claim 1, including a power density greater than about 1.5 lbf/in^3 and less than or equal to about 5.5 lbf/in^3.

20. The engine as recited in claim 1, wherein the second turbine includes at least two stages and performs at a first pressure ratio and the fan drive turbine includes more than two stages and performs at a second pressure ratio less than the first pressure ratio.