CLAIMS

What is claimed is:

1. A gas turbine engine comprising:

a fan including a plurality of fan blades rotatable about an axis;

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 turbine and a second turbine, wherein the second turbine is disposed forward of the fan drive turbine and the fan drive turbine includes a plurality of turbine rotors with a ratio between the number of fan blades and the number of fan drive turbine rotors is greater than about 2.5; and

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

wherein the fan drive turbine has a first exit area and rotates at a first speed, the second turbine section has a second exit area 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.

2. The engine as recited in claim 1, wherein the performance ratio is above or equal to about 0.8.

3. The engine as recited in claim 1, wherein the first performance quantity is above or equal to about 4.

4. 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.

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

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

7. 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 rotate in a second direction opposite the first direction about the axis.

8. 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.

9. The engine as set forth in claim 1, wherein said 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.

10. The engine as set forth in claim 9, wherein the bypass ratio is greater than about 10.0.

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

12. The engine as set forth in claim 1, wherein said fan has about 26 or fewer blades.

13. The engine as set forth in claim 12, wherein said fan drive turbine section has up to 6 stages.

14. The engine as set forth in claim 1, wherein the ratio between the number of fan blades and the number of fan drive turbine rotors is less than about 8.5.

15. The engine as set forth in claim 1, wherein a pressure ratio across the fan drive turbine is greater than about 5:1.

16. 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.

17. The engine as recited in claim 1, 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 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 axially aft of a second connection between the second aft rotor and the second shaft.

18. The engine as recited in claim 1, 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 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 axially forward of a second connection between the second aft rotor and the second shaft.

19. The engine as recited in claim 1, 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 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.

20. The engine as recited in claim 1, 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 a first bearing assembly is disposed axially forward of a first connection

between the first aft rotor and the first shaft, and a second bearing assembly is disposed axially aft of a second connection between the second aft rotor and the second shaft.

CLAIMS

1. A gas turbine engine comprising:

a fan including a plurality of fan blades rotatable about an axis;

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, wherein the second turbine is disposed forward of the fan drive turbine and the fan drive turbine includes a plurality of turbine rotors with a ratio between the number of fan blades and the number of fan drive turbine rotors is greater than 2.5; and

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

wherein the turbine section includes a volume defined within an inner periphery and an outer periphery between a leading edge of a most upstream vane to a trailing edge of a most downstream rotating airfoil and is configured to provide a thrust density greater than 1.5 lbf/in^3 and less than or equal to 5.5 lbf/in^3 at Sea Level Takeoff Thrust.

2. 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.

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

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

5. 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 rotate in a second direction opposite the first direction about the axis.

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

7. The engine as set forth in claim 1, wherein said 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 6.0.

8. The engine as set forth in claim 7, wherein the bypass ratio is greater than 10.0.

9. The engine as set forth in claim 1, wherein a fan pressure ratio across the fan is less than 1.5.

10. The engine as set forth in claim 1, wherein said fan has 26 or fewer blades.

11. The engine as set forth in claim 10, wherein said fan drive turbine section has up to 6 stages.

12. The engine as set forth in claim 1, wherein the ratio between the number of fan blades and the number of fan drive turbine rotors is less than 8.5.

13. The engine as set forth in claim 1, wherein a pressure ratio across the fan drive turbine is greater than 5:1.

14. The engine as recited in claim 1, 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 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 axially aft of a second connection between the second aft rotor and the second shaft.

15. The engine as recited in claim 1, 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 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 axially forward of a second connection between the second aft rotor and the second shaft.

16. The engine as recited in claim 1, 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 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.

17. The engine as recited in claim 1, 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 a first bearing assembly is disposed axially forward of a first connection between the first aft rotor and the first shaft, and a second bearing assembly is disposed axially aft of a second connection between the second aft rotor and the second shaft.