[0038] The engine 20 in one example is a high-bypass geared aircraft engine. In a further example, the engine 20 bypass ratio is greater than about six (6), with an example embodiment being greater than ten (10), the geared architecture 48 is an epicyclic gear train, such as a star gear system or other gear system, with a gear reduction ratio of greater than about 2.3 and the low pressure turbine 46 has a pressure ratio that is greater than about 5. In one disclosed embodiment, the engine 20 bypass ratio is greater than about ten (10:1), the fan diameter is significantly larger than that of the low pressure compressor 44, and the low pressure turbine 46 has a pressure ratio that is greater than about 5:1. Low pressure turbine 46 pressure ratio is pressure measured prior to inlet of low pressure turbine 46 as related to the pressure at the outlet of the low pressure turbine 46 prior to an exhaust nozzle. It should be understood, however, that the above parameters are only exemplary of one embodiment of a geared architecture engine and that the present invention is applicable to other gas turbine engines including direct drive turbofans.

[0039] A significant amount of thrust is provided by the bypass flow B due to the high bypass ratio. The fan section 22 of the engine 20 is designed for a particular flight condition -- typically cruise at about 0.8 Mach and about 35,000 feet. The flight condition of 0.8 Mach and 35,000 ft, with the engine at its best fuel consumption - also known as "bucket cruise Thrust Specific Fuel Consumption ('TSFC')" - is the industry standard parameter of lbm of fuel being burned per hour divided by lbf of thrust the engine produces at that minimum point. "Fan pressure ratio" is the pressure ratio across the fan blade alone, without a Fan Exit Guide Vane ("FEGV") system. The low fan pressure ratio as disclosed herein according to one non-limiting embodiment is less than about 1.45. "Low corrected fan tip speed" is the actual fan tip speed in ft/sec divided by an industry standard temperature correction of [(Tambient deg R) / 518.7)^0.5]. The "Low corrected fan tip speed" as disclosed herein according to one non-limiting embodiment is less than about 1150 ft / second.

[0040] A fan shaft 60 interconnects the geared architecture 48 to the fan 42. The fan shaft 60 is supported by a pair of bearings 38, which are tapered roller bearings in one example. The bearings normally limit the axial travel of the fan shaft 60 and fan 42. During operation, the engine 20 may experience extreme events such as a fan blade loss or a failure of a fan shaft bearing support 62 supporting the bearings 38, which is part of the engine static

CLAIMS

What is claimed is:

1. A support assembly for a geared architecture comprising:

an engine static structure;

a flex support secured to the engine static structure and including a bellow;

a support structure operatively secured to the flex support;

a geared architecture mounted to the support structure; and

first members removably secured to one of the engine static structure and the flex support, and second members removably secured to the support structure, the first and second members circumferentially aligned with one another and spaced apart from one another during a normal operating condition, and the first and second members configured to be engageable with one another during an extreme event to limit axial movement of the geared architecture relative to the engine static structure.

2. The support assembly according to claim 1, wherein the flex support includes an end opposite the bellow, the first members removably secured to the end.

3. The support assembly according to claim 2, wherein the end is an annular mounting flange.

4. The support assembly according to claim 1, wherein the support structure includes a torque frame and a carrier, the second members is removably secured to at least one of the torque frame and the carrier.

5. The support assembly according to claim 4, wherein the support structure includes a lubrication manifold, the second members removably secured to the carrier and the lubrication manifold.

6. The support assembly according to claim 5, wherein the lubrication manifold is arranged axially between the carrier and the second member, engaging the lubrication manifold.

7. The support assembly according to claim 1, comprising threaded fasteners removably securing the first and second members to the flex support and the support structure.

8. A method of retrofitting a support assembly to a gas turbine engine having a geared architecture, comprising the steps of:

providing attachment features in first and second structures;

securing first and second members respectively to the first and second structures;

arranging the first and second members in axially spaced relation to one another in an installed condition; and

installing the first structure onto an engine static structure and a geared architecture onto the second structure.

9. The method according to claim 8, wherein the attachment feature providing step includes providing machined surfaces on the first and second structures.

10. The method according to claim 9, wherein the first structure is a flex support having a bellow and an annular mounting flange opposite the bellow, the securing step includes mounting the first members to the annular mounting flange.

11. The method according to claim 10, wherein the securing step includes mounting a lubrication manifold onto the second structure, and securing the second members over the oil manifold.

12. The method according to claim 11, wherein the installing step includes securing a torque frame to the flex support and a carrier, the carrier supporting the geared architecture.

13. The method according to claim 8, wherein the arranging step includes positioning the first and second members in a first angular position relative to one another, and rotating the first and second members from the first angular position to a second angular position against a stop.

14. The method according to claim 8, wherein the securing steps include tightening threaded fasteners.

15. The method according to claim 14, wherein the securing step relating to the second members includes selecting fasteners having a length longer than a length of pre-existing fasteners at the attachment feature, which are removed during retrofitting.

16. A gas turbine engine comprising:

an engine static structure;

a flex support secured to the engine static structure and including a bellow;

a support structure operatively secured to the flex support;

a geared architecture mounted to the support structure;

a fan section operatively coupled to the geared architecture; and

first members removably secured to one of the engine static structure and the flex support, and second members removably secured to the support structure, the first and second members circumferentially aligned with one another and spaced apart from one another during a normal operating condition, and the first and second members configured to be engageable with one another during an extreme fan section event to limit axial movement of the geared architecture relative to the engine static structure.

17. The gas turbine engine according to claim 16, comprising low and high spools, low pressure compressor and turbine sections mounted on the low spool, and high pressure compressor and turbine sections mounted on the high spools, the low spool operatively coupled to the geared architecture.

18. The gas turbine engine according to claim 16, wherein the geared architecture is a planetary gear train.

19. The gas turbine engine according to claim 16, wherein the fan section includes a fan shaft supporting a fan, the fan shaft supported relative to the engine static structure by bearings.

20. The gas turbine engine according to claim 16, comprising threaded fasteners removably securing the first and second members to the flex support and the support structure.

[0038] The engine 20 in one example is a high-bypass geared aircraft engine. In a further example, the engine 20 bypass ratio is greater than about six (6), with an example embodiment being greater than ten (10), the geared architecture 48 is an epicyclic gear train, such as a star gear system or other gear system, with a gear reduction ratio of greater than about 2.3 and the low pressure turbine 46 has a pressure ratio that is greater than about 5. In one disclosed embodiment, the engine 20 bypass ratio is greater than about ten (10:1), the fan diameter is significantly larger than that of the low pressure compressor 44, and the low pressure turbine 46 has a pressure ratio that is greater than about 5:1. Low pressure turbine 46 pressure ratio is pressure measured prior to inlet of low pressure turbine 46 as related to the pressure at the outlet of the low pressure turbine 46 prior to an exhaust nozzle. It should be understood, however, that the above parameters are only exemplary of one embodiment of a geared architecture engine and that the present invention is applicable to other gas turbine engines including direct drive turbofans.

[0039] A significant amount of thrust is provided by the bypass flow B due to the high bypass ratio. The fan section 22 of the engine 20 is designed for a particular flight condition - typically cruise at about 0.8 Mach and about 10,668 metres{m} (35,000 feet {ft}). The flight condition of 0.8 Mach and 10,668 m (35,000 ft), with the engine at its best fuel consumption - also known as "bucket cruise Thrust Specific Fuel Consumption ('TSFC')" - is the industry standard parameter of lbm of fuel being burned per hour divided by lbf of thrust the engine produces at that minimum point. "Fan pressure ratio" is the pressure ratio across the fan blade alone, without a Fan Exit Guide Vane ("FEGV") system. The low fan pressure ratio as disclosed herein according to one non- limiting embodiment is less than about 1.45. "Low corrected fan tip speed" is the actual fan tip speed in ft/sec divided by an industry standard temperature correction of [(Tambient deg R) / 518.7) <Λ>0.5]. The "Low corrected fan tip speed" as disclosed herein according to one non-limiting embodiment is less than about 350.52 m/s (1150 ft/s).

[0040] A fan shaft 60 interconnects the geared architecture 48 to the fan 42. The fan shaft 60 is supported by a pair of bearings 38, which are tapered roller bearings in one example. The bearings normally limit the axial travel of the fan shaft 60 and fan 42. During operation, the engine 20 may experience extreme events such as a fan blade loss or a failure of a fan shaft bearing support 62 supporting the bearings 38, which is part of the engine static structure 36. In such events, the fan 42 may undesirably tend to move axially forward relative to the other portions of the engine 20, such that the fan 42 and associated components could become disengaged from the engine 20.

CLAIMS

1. A support assembly for a geared architecture comprising:
   an engine static structure;
   a flex support secured to the engine static structure and including a bellow;
   a support structure operatively secured to the flex support;
   a geared architecture mounted to the support structure; and
   first members removably secured to one of the engine static structure and the flex support, and second members removably secured to the support structure, the first and second members circumferentially aligned with one another and spaced apart from one another during a normal operating condition, and the first and second members configured to be engageable with one another during an extreme event to limit movement of the geared architecture relative to the engine static structure in at least an axial direction away from the flex support.

2. The support assembly according to claim 1, wherein the flex support includes an end opposite the bellow, the first members removably secured to the end.

3. The support assembly according to claim 2, wherein the end is an annular mounting flange.

4. The support assembly according to claim 1, wherein the support structure includes a torque frame and a carrier, the second members are removably secured to at least one of the torque frame and the carrier.

5. The support assembly according to claim 4, wherein the support structure includes a lubrication manifold, the second members removably secured to the carrier and the lubrication manifold.

6. The support assembly according to claim 5, wherein the lubrication manifold is arranged axially between the carrier and the second members.

7. The support assembly according to claim 1, comprising threaded fasteners removably securing the first members and the second members to the flex support and the support

structure.

8. A method of retrofitting a support assembly to a gas turbine engine having a geared architecture, comprising the steps of:
providing attachment features in first and second structures;
securing first and second members respectively to the first and second structures;
arranging the first and second members in axially spaced relation to one another in an installed condition; and
installing the first structure onto an engine static structure and installing a geared architecture onto the second structure from a first position in a first direction toward the second structure, wherein the first and second members are configured to cooperate to limit movement of the geared architecture relative to the second structure in at least a second axial direction opposite the first direction, wherein the first structure is a flex support having a bellow and an annular mounting flange is arranged opposite the bellow.

9. The method according to claim 8, wherein the attachment features providing step includes providing machined surfaces on the first and second structures.

10. The method according to claim 9, wherein the securing step includes mounting the first members to the annular mounting flange.

11. The method according to claim 10, wherein the securing step includes mounting a lubrication manifold onto the second structure, and securing the second members over the lubrication manifold.

12. The method according to claim 11, wherein the installing step includes securing a torque frame to the flex support and a carrier, the carrier supporting the geared architecture.

13. The method according to claim 8, wherein the arranging step includes positioning the first and second members in a first angular position relative to one another, and rotating the first and second members from the first angular position to a second

angular position.

14. The method according to claim 8, wherein the securing steps include tightening threaded fasteners.

15. The method according to claim 14, wherein the securing step relating to the second members includes selecting fasteners having a length longer than a length of pre-existing fasteners at the attachment features, which are removed during retrofitting.

16. A gas turbine engine comprising:

an engine static structure;

a flex support secured to the engine static structure and including a bellow;

a support structure operatively secured to the flex support;

a geared architecture mounted to the support structure;

a fan section operatively coupled to the geared architecture; and

first members removably secured to one of the engine static structure and the flex support, and second members removably secured to the support structure, the first and second members circumferentially aligned with one another and spaced apart from one another during a normal operating condition, and the first and second members configured to be engageable with one another during an extreme fan section event to limit axial movement of the geared architecture relative to the engine static structure in at least a direction toward the fan section.

17. The gas turbine engine according to claim 16, comprising low and high spools, low pressure compressor and turbine sections mounted on the low spool, and high pressure compressor and turbine sections mounted on the high spools, the low spool operatively coupled to the geared architecture.

18. The gas turbine engine according to claim 16, wherein the geared architecture is a planetary gear train.

19. The gas turbine engine according to claim 16, wherein the fan section includes a fan shaft supporting a fan, the fan shaft supported relative to the engine static structure by bearings.

20. The gas turbine engine according to claim 16, comprising threaded fasteners removably securing the first members and the second members to the flex support and the support structure, respectively.

21. The method according to claim 8, wherein the first direction is an axial direction from a forward location toward a rearward location relative to the gas turbine engine.

22. The support assembly according to claim 5, wherein the lubrication manifold is annular.

23. The support assembly according to claim 6, wherein the lubrication manifold engages both the carrier and the second members.

24. The method according to claim 9, wherein the machined surfaces on the first and second structures respectively receive the first and second members in the securing step.

25. The method according to claim 11, wherein the second members engages the lubrication manifold and the second structure.

26. The method according to claim 8, wherein the first and second members are in axially interleaved spaced relation to one another in the installed condition.

27. The method according to claim 13, wherein the first and second members are in a non-interleaved relationship in the first angular position, and the first and second members are in an interleaved relationship in the second angular position.

28. The method according to claim 27, wherein the first and second members are configured to be engageable with one another during an extreme event to limit movement of the geared architecture relative to the engine static structure in a radial direction.

29. The method according to claim 1, wherein the first and second members are configured to cooperate to limit movement of the geared architecture relative to the second structure in a third direction normal to the first direction.

30. A support assembly for a geared architecture comprising:

an engine static structure;

a flex support secured to the engine static structure;

a support structure operatively secured to the flex support;

a geared architecture mounted to the support structure; and

first members secured to one of the engine static structure and the flex support, and

second members secured to the support structure, the first and second members circumferentially aligned with one another and spaced apart from one another during a normal operating condition, and the first and second members configured to be engageable with one another during an extreme event to limit movement of the geared architecture relative to the engine static structure in at least an axial direction away from the flex support.