

CLAIMS:

1. An electric propulsion system for an aircraft, the system comprising:
a nacelle defining a primary air flow path from an inlet end of the nacelle to an outlet
end of the nacelle;
5 an electric machine comprising:
a stator positioned in the nacelle and comprising one or more stator windings;
and
a rotor and fan assembly positioned in the primary flow path, the rotor and fan
assembly comprising:
10 a cylindrical fan shroud having a first end, a second end, an inner
surface, and an outer surface;
a plurality of rotor magnets positioned on the outer surface of the fan
shroud and concentric with the one or more stator windings;
a fan hub positioned concentrically interior of the fan shroud, the fan hub
15 having a first end, a second end, an inner surface, an outer
surface, and a fan axis of rotation, the fan hub being mounted on
a central support shaft via one or more bearings; and
a plurality of fan blades extending between the fan shroud and the fan
hub.
- 20 2. The system of claim 1, wherein the plurality of rotor magnets are loaded in
compression in a radial direction when the rotor and fan assembly is at rest.
3. The system of claim 2, wherein the rotor and fan assembly further comprises a sleeve
for securing the plurality of rotor magnets to the cylindrical fan shroud.
4. The system of claim 3, wherein the sleeve is a compression sleeve that applies a
25 compressive load to the plurality of rotor magnets.
5. The system of any one of claims 1 to 4, wherein an outer end of each fan blade is
secured directly to the inner surface of the fan shroud.

6. The system of claim 5, wherein the outer end of each fan blade is secured to the inner surface of the fan shroud via a dovetail joint.
7. The system of any one of claims 1 to 6, wherein the plurality of fan blades are pre-stressed in a radial direction when the rotor and fan assembly is at rest.
- 5 8. The system of claim 7, wherein an inner end of each fan blade has a fan blade base, and further comprising at least one nut positioned between each fan blade base and the fan hub, wherein the at least one nut applies a compressive load in the radial direction to that fan blade.
9. The system of claim 8, wherein each fan blade base has a projecting feature on one
10 side of the fan blade base and a complementary recess on an opposite side of the fan blade base for receiving the projecting feature of an adjacent fan blade base.
10. The system of any one of claims 1 to 9, wherein the plurality of rotor magnets are positioned in a Halbach configuration.
11. The system of any one of claims 1 to 10, wherein the one or more stator windings
15 comprise polyphase fault tolerant windings.
12. The system of claim 11, wherein the polyphase windings comprise at least three phases.
13. The system of any one of claims 1 to 12, further comprising a plurality of guide vanes positioned in the primary air flow path downstream of the electric machine to promote
20 redirection of circumferential air flow resulting from rotation of the rotor and fan assembly relative to the nacelle towards axial air flow.
14. The system of claim 13, wherein the plurality of guide vanes provide structural support for the central support shaft.
15. The system of any one of claims 1 to 14, wherein the stator has an inner stator
25 diameter and an axial stator length, and wherein the inner stator diameter is at least 4 times greater than the axial stator length.

16. The system of claim 15, wherein the inner stator diameter is at least 10 times greater than the axial stator length.
17. The system of claim 16, wherein the inner stator diameter is at least 20 times greater than the axial stator length.
- 5 18. The system of any one of claims 1 to 17, wherein the stator has an inner diameter, and further comprising a stator enclosure for housing the stator, the stator enclosure comprising:
- 10 an annular casing positioned concentrically around the stator, the annular casing having a first end, a second end, an inner surface, and an outer surface, a casing diameter;
- a front stator face plate coupled to the first end of the annular casing, the front stator face plate having an inner diameter generally aligned with the inner diameter of the stator; and
- 15 a rear stator face plate coupled to the second end of the annular casing, the rear stator face plate having an inner diameter generally aligned with the inner diameter of the stator.
19. The system of claim 18, wherein power electronics for the one or more stator windings are coupled to the annular casing.
20. The system of claim 18, wherein the annular casing and at least one of the front stator face plate and the rear stator face plate are integrally formed.
21. The system of any one of claims 18 to claim 20, wherein a plurality of cooling fins are provided on a front surface of the front stator face plate.
22. The system of any one of claims 18 to 21, further comprising a plurality of condensers positioned around the stator enclosure.
- 25 23. The system of claim 22, further comprising a plurality of air flow ducts, each of the air flow ducts positioned to direct air into an upstream end of one of the plurality of condensers.

24. The system of claim 22 or claim 23, further comprising heat pipes in thermal communication with the plurality of condensers and with at least one of the one or more stator windings.
25. The system of any one of claims 1 to 24, wherein the rotor and fan assembly further
5 comprises a rotor cooling system.
26. The system of claim 25, wherein the rotor cooling system comprises at least one rotor heat pipe in thermal communication with each of the plurality of rotor magnets, each rotor heat pipe being configured to promote oscillatory motion of fluid within that rotor heat pipe in response to a temperature difference between that rotor magnet and ambient air.
- 10 27. The system of any one of claims 1 to 26, wherein the cylindrical fan shroud has an axial shroud length, the plurality of fan blades has an axial blade length, and wherein the axial shroud length no more than 105% of the axial blade length.
28. The system of any one of claims 1 to 27, wherein the rotor and fan assembly further comprises a nose cone coupled to the first end of the fan hub.
- 15 29. The system of any one of claims 1 to 28, further comprising a hub fairing positioned downstream of the rotor and fan assembly.
30. The system of claim 29, further comprising a linear actuator coupled to the hub fairing, wherein the hub fairing may be selectively moved between an extended position in which at least a portion of the hub fairing is positioned in an exit nozzle of the nacelle, and a retracted
20 position in which the hub fairing is proximate the fan hub.
31. An aircraft comprising an electric propulsion system according to any one of claims 1 to 28.