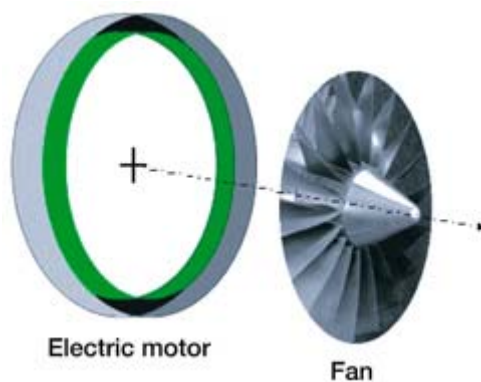


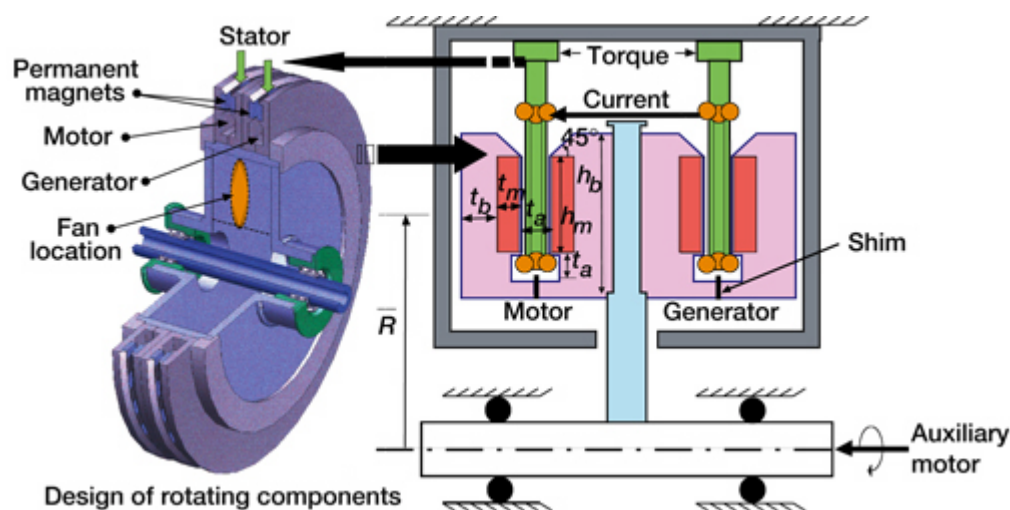
# "Fan-Tip-Drive" High-Power-Density, Permanent Magnet Electric Motor and Test Rig Designed for a Nonpolluting Aircraft Propulsion Program



*Blade tip fan drive.*

Long description. Aircraft propulsion fan surrounded by tip drive electric motor.

A scaled blade-tip-drive test rig was designed at the NASA Glenn Research Center. The rig is a scaled version of a direct-current brushless motor that would be located in the shroud of a thrust fan. This geometry is very attractive since the allowable speed of the armature is approximately the speed of the blade tips (Mach 1 or 1100 ft/s). The magnetic pressure generated in the motor acts over a large area and, thus, produces a large force or torque. This large force multiplied by the large velocity results in a high-power-density motor.



Design of rotating components  
Operation of blade tip fan drive rig. Power, 115 kW; voltage, 576 V; current, 50 A;

*torque, 84.4 ft-lb; speed, 9550 rpm; radius of armature,  $R$ , 12 in.; thickness of back-iron,  $t_b$ , 0.5 in.; thickness of stator,  $t_a$ , 0.25 in.; thickness of magnets,  $t_m$ , 0.375 in.; height of magnets,  $h_m$ , 1.2 in.*

Long description. Schematic model of rig compared with solid model version showing the rig operation. Shows stator, motor, generator, permanent magnets, fan location, torque and current direction, shim, and auxiliary motor.

The goal of the test program is to maximize both the armature speed and the stator current density, thus producing a very high power density motor. The unique feature of the rig is that a generator provides the electrical current and voltage to drive the motor. The test motor and an auxiliary motor provide the torque to drive the generator. The auxiliary motor will also control the speed of the test rig. Later a pulse-width-modulated motor drive will be developed to drive the motor, and the torque will be absorbed by the generator.



*Assembly of blade tip fan drive rig.*

Long description. Solid model version showing the assembly of various components in the rig.

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