Superconducting Super Motor and Generator

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***Abstract*— We have developed a new type of superconducting synchronous rotating machine whose self-induction is cancelled out, with the intention of achieving a very high power-to-weight ratio including the weight of the cooling system. Magnetic cores are used to direct the magnetic field from permanent magnets on the rotors onto superconducting wires on the stator, and the reaction of the Lorenz force is used to drive the rotors. Cancellation of self-induction in the cores enables the elimination of core-losses and magnetic saturation, permitting the core mass to be reduced significantly, and also reducing ac losses in the superconducting wires. In this work a prototype prepared using 100 m of second generation high temperature superconductor (2G-HTS) wire is described, and its characteristics are measured and compared with a numerical simulation. The ac losses in the superconducting wires, which dominate internal losses in this machine, are estimated at about 1 W/Hz at 77 K. We conclude that electrical rotating machines with power-to-weight ratios comparable to jet engines could be developed with 2G-HTS wire.**

***Keywords (Index Terms)*— High-temperature superconductor, motors, generators, rotating machines.**

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