Vernier Motor Uses Less Rare Earth Materials

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WARF: P130317US01 View U.S. Patent No. 9,595,858 in PDF format.

The Wisconsin Alumni Research Foundation (WARF) is seeking commercial partners interested in developing a ferrite-based permanent magnet vernier machine that provides good torque.

OVERVIEW

Rare earth magnets, like neodymium and dysprosium, are used in permanent magnet (PM) motors found in wind turbines and hybrid/electric vehicles. The cost of rare earth materials is escalating because of resource depletion and foreign monopoly.

In response, manufacturers are searching for motor designs that can provide good torque using only ferromagnetic material (iron, cobalt, nickel, etc.). However, many of these ferrite-based designs are bulky, producing one-third of the flux densities achieved by rare earth machines.

A relatively new machine with great promise for low-speed applications is the permanent magnet vernier machine (PMVM). This motor has the potential to create torque well beyond other types of PM machines and compete with rare earth material-based designs.

THE INVENTION

UW–Madison researchers have developed a new vernier machine that outperforms other PMVM designs.

The new motor features a central rotor with spokes of magnets. The magnets can be ferrite-based or made of a minimal amount of rare earth material. The rotor is sandwiched by a pair of notched stators, each separated from the rotor by an air gap and wound by stator windings that form magnetic poles. In contrast to traditional PM machines, the number of rotor magnetic pole pairs is much greater than the number of stator winding pole pairs. Still, the motor is able to achieve smooth torque given its design.

In effect, the new design produces a rotating magnetic field that travels much faster around the air gap than the rotor. Increased rate of change of flux linkage means more voltage is induced.
APPLICATIONS

• Wheel motors for hybrid vehicles
• Generators

KEY BENEFITS

• Outperforms other vernier PM motors
• Produces good torque
• Uses inexpensive ferrite magnets/minimizes rare earth material
• Much less bulky than other designs

ADDITIONAL INFORMATION

Related Technologies
WARF reference number P02287US describes a dual-rotor, radial-flux, toroidally-wound, PM machine with high efficiency and torque density.

Tech Fields
Engines & Power Electronics - Motors

CONTACT INFORMATION

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