

Magnetic Gearing Attracting More Followers?

“Going green” and energy efficiency are goals that all industries—especially in Europe and the United States—are working on, in such sectors as electric motors, lubrication, gears and on and on. Drumroll here please for magnetic gearing, or, more precisely—magnetic transmission technology. It is a concept now being utilized in wind and marine turbines; marine propulsion; hybrid and all-electric vehicles; ancillary drives; flight surface actuation; landing gear deployment; mining crushers; conveyors; and earth moving equipment.

A pioneer in magnetic gearing, Magnomatics Ltd (magnomatics.com) is located in Sheffield England. It was established in 2006 as an adjunct entity of the University of Sheffield charged with commercializing their research in the areas mentioned above. In charge of the technical aspects of the operation are Dr. Kais Atallah and Professor David Howe, from the electrical machines and drives research group at the University.

According to the Magnomatics website, magnetic gearing is both an environmental and performance upgrade over traditional gearing because of the following attributes: reduced maintenance and improved reliability; lubrication-free; higher efficiency than conventional gears; precise peak torque transmission and inherent overload protection; physical isolation between input and output shafts; inherent anti-jamming transmission; significantly reduces harmful drivetrain pulsations; allows for misalignment/vibration of shafts; and very low acoustic noise and vibration.

The company site includes what might be construed as a mission statement:

“Our technology allows a step-change improvement in a broad range of applications and industries in which a high torque density (i.e., reduced size/mass), high efficiency or improved reliability is desirable. Our engineers have extensive experience in bespoke design for cus-

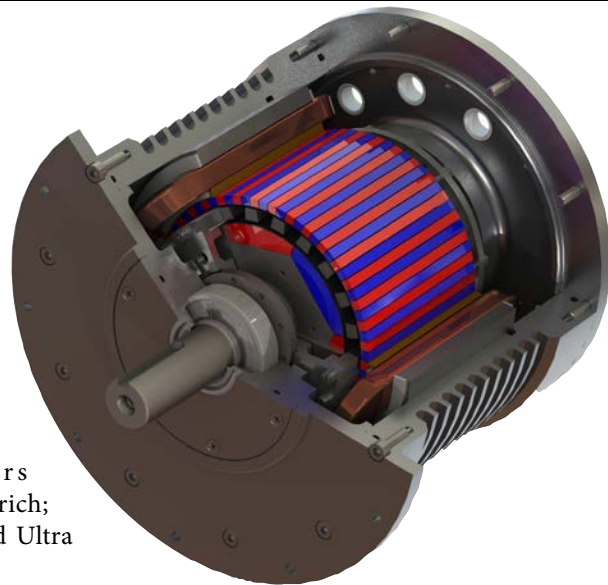
tom-specific applications and can quickly quantify the benefits that our technology can offer.”

Magnomatics customers include: Messier-Bugatti; Goodrich; Turbo Technologies; Macon; and Ultra Electronics.

Two of the more intriguing developments being marketed by the company are a magnetics-based CVT and IVT, and what Magnomatics calls a PPD machine.

The CVT (or contactless, high-efficiency continuously variable transmission system with inherent overload protection), and IVT (infinitely variable transmission), according to a website description, boast high efficiency; contactless, lubrication-free variable transmission; inherent overload, torque fuse capability; and speed of prime mover matched with variable speed load. The magnetic CVT is said to allow a variable speed drive to be connected to a fixed speed load, to be highly efficient and compact, to require no cooling or lubrication and to be suitable for applications as diverse as hybrid vehicles and wind turbines.

The company’s PDD machine is an extension of the low-ratio magnetic gear; it was invented and demonstrated by Magnomatics in 2005. According to the company, it is arguably regarded as the most significant advancement in electrical machine design in the past 20 years. The new technology combines the high-torque density of the magnetic gear and the functionality and performance of a brushless, permanent magnet machine to offer robust torque output for direct drive applications. Performance claims for the PPD technology include: significant size reduction over conventional direct drive machines; ultra-high efficiency that eliminates the need for ancillary cooling; reduced maintenance and improved reliability over mechanically geared drives; inherent torque overload



protection; high power factor (typically >0.9); standard power electronic controllers; and the possibility for two output shafts with different rotational speeds.

And lest you might be thinking this all sounds like blue-sky, over-the-top claptrap, consider that Magnomatics in 2012 received £2.5 million (> \$4,382,000 U.S.) in funding to develop magnetically geared motors and generators for the hybrid and electric vehicle market. They also were recognized with a £100,000 (> \$151,000 U.S.) Smart award to help in developing its next-generation MAGSPLIT product, a power-split device that combines the functionality of a magnetic gear and a motor generator in a compact unit. It substantially improves system efficiency and, therefore, fuel economy, compared to the mechanical gear and motor/generator combination found in many of today’s hybrid cars.

And presently, Magnomatics is working with strategic partners to develop: high-efficiency and ultra-compact generators to address the challenging requirements of wind and tidal energy production; ultra-compact and efficient marine propulsion systems; wheel hub motors and continuously variable transmissions that allow flexible system topologies for commercial hybrid and electric vehicles; and fluid-free, low-mass actuators for aircraft flight surfaces. ⚙️

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