DEVELOPMENT OF A HERMETICALLY SEALED MAGNETICALLY GEARED GENERATOR FOR MARINE HYDROKINETIC ENERGY GENERATION

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Magnetic gearing is a means for non-contact transmission of torque, that has been investigated in recent years as an enabling technology for wind and ocean energy generation. By using the interaction of magnetic fields in place of physically meshing gear teeth, many wear and overload based failure mechanisms can be eliminated from the drive train. Elimination of these failure mechanisms reduces the need for service, maintenance, and repairs and the associated impacts on the levelized cost of energy (LCOE) for the overall system.

Prior research has focused on improving the performance of magnetic gears, by increasing the achievable torque densities and gear ratios, to make magnetic gears a viable replacement for mechanical gearboxes. This work expands upon that research to develop a multi-stage magnetically geared generator that utilizes magnetic fields to transmit torque through a hermetically sealed enclosure. The enclosure contains the components for converting rotational kinetic energy into electrical energy (stator, rotor, etc.). Using the magnetic fields in this way allows designers to avoid the more complicated task of sealing (and maintaining a seal) around a rotating shaft and instead seal around a simple power cable.

This particular design employs a coaxial magnetic arrangement, where the flux is modulated in the radial direction between three rotors; an inner rotor, an outer rotor, and an intermediate flux modulating rotor (commonly referred to as the cage rotor). In prior designs, the outer rotor has been held fixed, while the cage rotor served as the high torque-low speed input shaft and the inner rotor served as the high speed output. In this design, the flux modulating cage elements are integrated into the enclosure, the outer rotor serves as the high torque-low speed input, and the inner rotor operates at the higher speeds required for generating electricity.

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