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Tue-Af-Po2.25-10 [120]: A Novel Slotted Magnetic Gear with Spoke and Inset Permanent Magnets

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Compared with mechanical gear, Magnetic gear has the advantage of low acoustic noise, low vibrations, reduced maintenance and inherent overload protection. Although magnetic gears have many merits, the utilization of PMs and torque density of magnetic gears are extremely low due to the influence of parallel-axis topologies. In recent years, coaxial magnetic gear (CMG) has been put forward, and the utilization of PMs are obviously improved. In order to reduce material costs and increase the torque density, it is still very necessary to research the magnetic gear with simple structure and high torque density. In this paper, a novel structure of magnetic gear is proposed, which has higher torque density and mechanical properties than conventional magnetic gears. The permanent magnets (PMs) of the outer rotor are spoked and magnetized along the tangential direction. The PMs of inner rotor are the surface-mount type and magnetized in the radial direction. The PMs are fixed in the inner and outer rotors' iron yoke so as to keep the PMs from falling off during the rotation. In order to reduce the usage of iron, it is considered to notch slots on the outer rotor. The two-dimensional finite element method is used for simulating the proposed model. The magnetic field and electromagnetic torque of the magnetic gear are calculated. Finally, a prototype of a CMG is built and tested, and the experimental results show that the torque transmission capability of the CMG can be substantially improved, and its transmission efficiency is above 90%. When the load torque reaches $116.5\text{N}\cdot\text{m}$, the effective length of the prototype corresponds to the torque density is $135.07\text{kN}\cdot\text{m}/\text{m}^3$.

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