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Characteristic Analysis of Novel Outer Rotor Fan-type PMSM for Increasing Power Density

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Rare earth permanent magnet motors are used in many industrial fields because of the advantage of superior output power density. Currently, however, non-rare earth motors have been actively studied due to the instability of rare earth supply and price fluctuations. Example of non-rare earth motors includes a synchronous reluctance motor (SynRM), a wound rotor synchronous motor (WRSM), a spoke-type PMSM and so on. The SynRM is the motor using differences in d-q axis inductance through the barrier structure at a rotor part, and it has only reluctance torque because of not having the magnets. The WRSM is the motor composed of N and S pole using the winding. Finally, the spoke-type PMSM is the motor using non-rare earth permanent magnets with a low residual magnetic flux density instead of rare earth permanent magnets. Therefore, the spoke-type PMSM forms structures that can concentrate the magnetic flux of the permanent magnet in order to improve the output power. However, these non-rare earth motors are mainly inner rotor type motors, and little research has been conducted to replace outer rotor type rare earth permanent magnet motors. Accordingly, this paper suggested an outer rotor fan-type PMSM using the non-rare earth permanent magnets to replace an outer rotor SPMSM which is mainly used as outer rotor type. The outer rotor fan-type PMSM has structures that can concentrate permanent magnet flux similar to the spoke-type PMSM. In order to verify the superiority of the outer rotor fan-type PMSM, this paper includes a comparative analysis of output power and efficiency with the outer rotor SPMSMs. Also, it deals with the analysis of characteristics of the detailed designed outer rotor fan-type PMSM according to the current phase angle. Finally, prototype tests show actual results.

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