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Novel 4/4 Stator/Rotor Single-Phase Asymmetric Stator-Pole Doubly Salient Machine with Permanent Magnets on Stator Teeth

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Recently electric tools have been widely used in industrial applications and human livings, and will be increased very greatly in near future. Till now, most electric tools have been driven by concatenated induction machine, which suffers big volume, low torque density, low efficiency, poor reliability, etc. Fortunately, single-phase doubly salient permanent magnet machine (SP-DSPMM) has been decided as one good candidate for electric tools due to its advantages over high torque density, high efficiency, high reliability, low maintenance, etc. However, the traditional SP-DSPMM up to now has poor starting capability and relatively large torque ripple, which limits its wide application in electric tools. Thus, one novel 4/4 stator/rotor single-phase asymmetric stator-pole doubly salient machine with permanent magnets on stator teeth is proposed in this paper. The stator poles for the proposed machine are distributed non-uniformly along the circumference. More specifically, the angle between adjacent stator poles is 45 degrees. The radially magnetized permanent magnets are placed on the stator teeth. Full-pitch winding is adopted in the proposed machine, which is similar to that of traditional SP-DSPMM. The rotor is rather simple and very suitable for high speed application. This paper is organized as follows. Firstly, the research background of driving motor for electric tools is introduced briefly. Then, it investigates the new topology and operation principle based on diagram description and mathematical derivation. And then, the two-dimensional finite element analysis (2D FEA) models for the proposed and traditional machine are made and optimized based on the given specifications. Finally, comprehensive comparison on main electromagnetic performance indexes for the optimal machines are performed, including starting torque, average torque, efficiency and so on. It indicates that the proposed machine enjoys higher torque density, lower torque ripple, higher efficiency, higher starting torque, etc. More details will be given in the final paper.

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