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The Number of Magnet Poles Decision Method of Magnetic Gear for Torque Ripple Reduction

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Mechanical gears, which are employed in the many fields of modern industry, are used mostly for power-transmitting mechanical devices. However, because the mechanical gear operates, in principle, by the engagement of gear teeth, it is difficult to avoid problems such as friction loss from physical contact, noise, and vibration. To address this problem, magnetic gears have been proposed as a substitute for mechanical gear trains owing to advantages like noise reduction, utility of maintenance, and low friction loss due to non-contact power transmission. Since the N and S poles always coexist in the permanent magnet, the poles of the permanent magnets must be composed of an even number. The characteristics of these permanent magnets limit the gear ratio configuration according to the combination of pole numbers of the magnetic gears. If the number of poles of the inner rotor is fixed to four poles and the number of poles of the outer rotor is arranged from four poles to twenty poles, the gear ratios are displayed at 0.5 intervals from 1: 1 to 5: 1. That is, when the number of poles of the inner rotor is 4, the gear ratio of the adjacent pole ratio combination is different by 0.5. Even if the gear ratio is immediately adjacent, it can be seen that the ripple value is up to 10 times or more. However, there are certain rules for this difference. In this paper, we have confirmed the regularity of the torque ripple according to the gear ratio. Therefore, the research result of this paper can provide design guideline that are essential for calculating the torque characteristics suitable for the application field in the design stage of the magnetic gear.

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