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## Flux Characteristics Analysis of Single-phase Tubular Permanent Magnet Linear Motor

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The flux characteristics of a single-phase tubular permanent magnet linear motor (TPMLM) is analyzed with magnetic equivalent circuit (MEC) method in this paper. The flux linkage of the proposed single-phase TPMLM is generated by the permanent magnets and the bread type windings. The magnetic lines of flux travel through the stator yoke, the stator sleeve, air gap, and the mover to form a closed flux loop. First of all, the single-phase TPMLM is mainly divided into five parts, including stator sleeve, stator yoke, air gap, the permanent magnetic part of mover, and the ferromagnetic part of mover. In consideration of saturation, the flux linkage of the single-phase TPMLM at four special mover positions can be calculated with the help of magnetic tube method and Gauss-Seidel iteration. The nonlinear relationship between flux linkage, mover position, and current can be mapped utilizing a high order Fourier series with the flux linkage data obtained from MEC method. It is consistent with 3-D FEM and experimental data. What's more, the simulated dynamic and static performance of the TPMLM are also consistent with experimental data, which verifies the effectiveness of the proposed MEC method.

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