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Tue-Af-Po2.20-08 [60]: A novel tubular switched reluctance linear machine shielding from end magnetic effect

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Traditional linear machines are under great influence of end effect because of their finite stacking lengths in transverse and longitudinal directions. Transverse end effect will produce a lot of flux leakage enclosed with air. Longitudinal end effect will cause imbalance of phase performance so that linear machine's force fluctuation is aggravated. In this paper, a novel tubular switched reluctance linear machine (TSRLM) is proposed, which can shield from unexpected impact of end effect. In structure, there is no transverse cut in tubular linear machines, so tubular linear machines are not influenced by transverse end effect. The stator sleeve of proposed TSRLM includes six ferromagnetic rings and five spacer rings. There are twelve salient poles on every stator ferromagnetic ring. The winding coils are all through windings. The mover is composed of an aluminum tube and several fan-shaped poles. The adjacent fan-shaped poles are placed at 120 degree intervals. The stator poles of energized phase only drag the the mover ferromagnetic rings with the same-direction fan-shaped poles. Three phases are energized alternatively, then, the mover reciprocates. It also operates according to the minimum reluctance principle. This structure makes cyclic arrangement of three-phase windings possible so that there is no deviation in phase at end or phase in the middle, and their coupling effects are balanced. Thus, this machine is also not influenced by longitudinal end effect. Then it is modeled by 3-D finite element method. The mutual inductance is also considered in this model. And a prototype is manufactured, and its corresponding hardware platform is established. A series of simulations and experiments verify that there is no deviation performance among phases. Traditional longitudinal end effect in linear machines caused by longitudinal cuts can be thoroughly evaded.

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