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Wed-Mo-Po3.05-10 [36]: A Novel Permanent Magnet Linear Generator

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A novel single phase tubular permanent magnet linear generator for Stirling engines is proposed in this paper. It has a bread type winding, which has no cutting. It comprises an outer-stator, an inner-stator and a mover, and they are mounted in a cylinder. The winding coils are wound in a ring shape and placed in the slot of the outer-stator. The inner-stator is made up of a ferromagnetic ring. The mover is drivingly linked to a piston and it consists of four ring-shaped permanent magnets that are all polarized radially, and the polarized direction of the two permanent magnets on the outside are in the opposite of that of the two magnets on the inside. The stator outer diameter is 80mm and the outer-stator laminated thickness is 22mm. The whole mover laminated thickness and the inner-stator laminated thickness are both 30mm. The inner-airgap is 0.2mm while the outer-airgap is 0.3mm. The silicon steel material of the outer-stator and inner-stator is 50W470. The permanent magnetic part of the mover is made up with Nd-Fe-B, and the non-magnetic support shaft is made up with aluminum. Taking the space of outer-stator's slot into consideration, the turns of diameter of the copper wire is selected as 71 and the diameter of the copper wire is chosen as 1.5mm when concerned about the output current value is approximately 10A. The three-dimensional finite element model of proposed TPMLG is established. The model and its boundary conditions are presented. Through the FE model, its electromagnetics analysis is carried out. The performance of this generator under reciprocating frequency 75Hz is investigated and analyzed. With the FE model, the weight of the iron core of outer-stator, inner-stator, coils of copper, mover with four permanent magnets and the support shaft are calculated thoroughly. The average power per unit mass is around 115.848W/kg. The advantages of the generator that it has high-power density are shown. It can be used as the generator in the Stirling engine.

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