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Influence on Magnet of Blushless DC Motor due to Load Torque Variation of Reciprocating Compressor

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Ferrite magnet material is cheap and provides good productivity o that it has been widely used in the BLDC motor. In a reciprocating compressor driven by the BLDC motor with ferrite magnet material, the instantaneous peak currents owing to large torque pulsations may generate demagnetizing fields and the permanent magnet can be demagnetized eventually [1]. This paper introduces the influence on magnet of BLDC motor due to load torque variation of the reciprocating compressor using two-dimensional (2-D) time-stepped finite-element method. Fig. 1 shows the measured gas and motor torque patterns of reciprocating compressor during suction, compression and discharging. The peak torque of a reciprocating compressor at compression reaches about 4 times the average load torque. Normally, most of refrigerator speed operation is low speed (under 2,000rpm) for high efficiency and low acoustic noise. Therefore, large torque pulsations cause serious demagnetization of the permanent magnets in the rotor at low speed. It is noted to design the BLDC motor in a reciprocating compressor by considering the peak load torque. Fig. 2 shows phase currents due to load torque variation at low speed (2,000rpm).

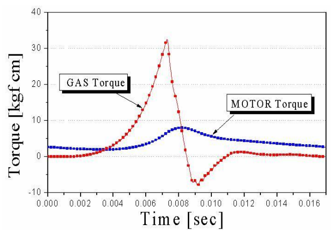
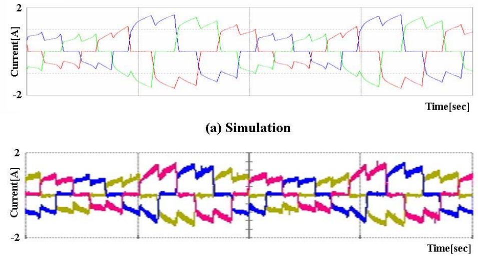


Fig. 1. Torque patterns of reciprocating compressors.



(a) Simulation

(b) Experiment

Fig. 2. Phase currents at low speed (2,000rpm).

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DD08

A Modular Permanent Magnet Flux-Switching Linear Motor with Fault-Tolerant Capability

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This paper describes a novel modular permanent magnet flux-switching (PMFS) linear motor, which is constituted of several modular units while each unit contains two 'U' shape lamination cores, a magnet and a concentrated coil, as shown in Fig. 1a. There is a flux barrier between the neighbouring units.

Compared with the conventional PMFS linear motor, as shown in Fig. 1b, the flux barrier replaces the magnet between two modular units, while the remaining magnets are arrayed of alternate polarity, as shown in Fig. 1a. This reduces the magnet volume by 50%. However, finite element analysis shows that the back electromotive force in a single-turn coil is slightly decreased, which means a more efficient use of magnets. The flux barrier can significantly decrease the magnetic coupling between phases. Thus the phase windings are essentially isolated, magnetically, thermally and physically. As a result, its fault tolerance is extraordinary high, which is a major consideration for safety-critical applications [1].

The open-slot design allows pre-forming of the coils, which can be impregnated with high thermal conductivity varnish and achieve a quite high copper fill factor. Moreover, the armature reaction field of saddle coil is essentially perpendicular to the axis of magnetization, hence, the risk of irreversibly demagnetizing the magnets is low. These two features allow high a peak power capability [2]. Additionally, the proposed machine can be easily assembled from modular units, and this is conducive to low cost, high-volume manufacturing.

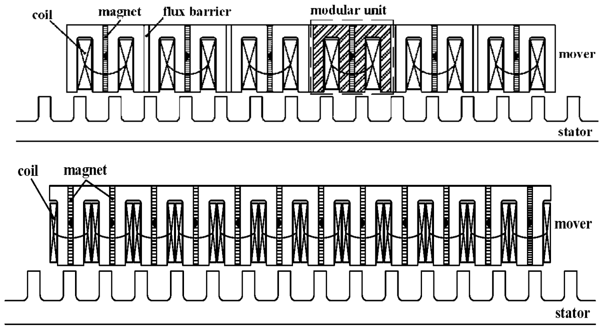

Fig. 1. Configuration. (a) proposed motor (b) conventional motor.

In conclusion, the proposed motor is ease to assemble and manufacture at rather low cost and propitious for safety-critical applications with high fault tolerance.

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