Coupled Field-Circuit Analysis for Characteristic Comparison in Barrier Type Switched Reluctance Motor

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Abstract **- This paper deals with two kinds of novel shape switched reluctance motors (SRMs) with magnetic barriers in order to improve operating performances of prototype. The configurations and specifications of the SRMs are introduced, and the operating performances are compared. The magnetic characteristics of each motor are obtained by coupled field-circuit method, and experiment results are presented to prove the accuracy of the method.**

Introduction

In reluctance motors, design of magnetic barrier or salient pole is important portion for overall design process because the number or configuration affects d- and q-axes inductances, and that can change operating performance. Most papers about reluctance motor design, however, consider either the magnetic barrier or salient pole only.

This paper deals with two kinds of novel shape switched reluctance motors (SRMs) with magnetic barriers to improve operating performances of prototype. The configurations and specifications of the SRMs are introduced, and the operating performances are compared in aspect of magnetic torque characteristic and efficiency. The magnetic characteristics are obtained by coupled field-circuit method [1,2], and experiment results are presented to prove the accuracy of the method.

Barrier type SRMs

The rotors of prototype and barrier-type are shown in Fig. 1. The motor named SBSRM has magnetic barriers, which are modelled on transverse–laminated synchronous reluctance motor. The magnetic barriers are optimised by response surface methodology to improve torque characteristics [1]. The other named PBSRM has partial magnetic barriers of SBSRM. This shape is designed by considering magnetic flux paths of general SRMs because main flux path directly crosses the rotor when same phase winding is opposite side and switch turn on and off by phases.

Comparison

In the SRMs, the indicator diagram is a closed locus on coordinates of phase flux linkage vs. phase current, traced out by the operating point as the rotor rotates through one stroke. The diagram enables the calculation of torque ripple [3]. Fig. 2 shows the diagrams of the three motors. These diagrams are obtained by analysis using coupled field-circuit method. Despite of same operating condition, the loci are different because of the magnetic barriers. According to this comparison, SBSRM has less torque ripple than that of prototype. Table I shows the several comparisons of performances under the same condition as Fig. 2. The more detail comparison and explanation will be presented in the extended paper.

References

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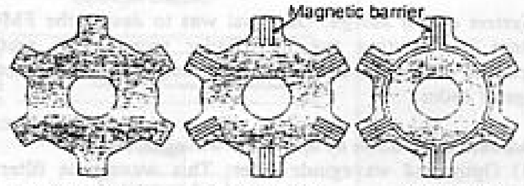

Figure 1. SRM configurations in comparison

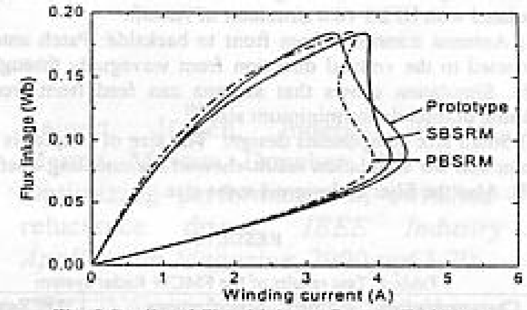

Fig. 2 Predicted Flux Linkage-Current Trajectory (@ V= 150V, 1800rpm)

Table I. Comparison of characteristics (unit: %)

	Prototype	PBSRM	SBSRM
Average torque	100	99.78	102.72
Torque ripple	100	85.68	79.64
Current (rms)	100	94.51	101.58
Average torque per Current	100	105.57	101.11

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