A Novel Stator Design of Synchronous Reluctance Motor by Loss & Efficiency Evaluations Related to Slot Numbers using Coupled Preisach Model & FEM

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Abstract - **This paper deals with the stator design of a synchronous reluctance motor (SynRM) with concentrated winding by loss & efficiency evaluations related to slot numbers using coupled Preisach modeling & FEM. The focus of this paper is the stator design relative to torque density and efficiency on the basis of stator slot number and teeth width in a SynRM. The coupled Finite Elements Analysis (FEA) & Preisach model have been used to evaluate the nonlinear solution. Comparisons are given with characteristics of SynRM according to stator slot number, teeth width variation, respectively**

I. Introduction

If stator windings of a SynRM are not a conventional distributed one but the concentrated one, the decreasing of copper loss and decreasing of the production cost due to the simplification of winding in factory are obtained.

However it is difficult to expect a good performance from concentrated winding SynRM without considering the defects of torque ripple, lower inductance ratio and difference (efficiency, power factor), etc.

This paper deals with the stator design of a synchronous reluctance motor (SynRM) with concentrated winding by loss & efficiency evaluations related to slot numbers using coupled Preisach modeling & FEM. The focus of this paper is the stator design relative to torque density and efficiency on the basis of stator slot number, teeth width, in order to improve performance and production cost problem of a SynRM.

The coupled Finite Elements Analysis (FEA) & Preisach model have been used to evaluate the nonlinear solution [1]-[2]. Comparisons are given with characteristics of normal distributed winding SynRM(24 slot) and those according to stator slot number, teeth width variation in concentrated winding SynRM(12, 6 slot), respectively. By means of these structures, anisotropy ratios up to 8 or more are obtained and the consequent torque performance approaches that of state of the art (distributed winding SynRM : 24 slot).

II. Analysis Model And Design

Starting from a standard motor of distributed winding SynRM, several optimized designs have been found according to design strategy of Fig.1. Fig. 2 show the d-axis flux plots of distributed (24 slot) and concentrated (12, 6 slot) winding SynRM, respectively. In this paper the slot number of a SynRM is considered those of 24 (distributed winding: 36 turn/slot), 12 and 6 (concentrated winding: 144 turn/ slot). The number of slot is a variable, which is related to torque ripple production together with the number of flux barrier.

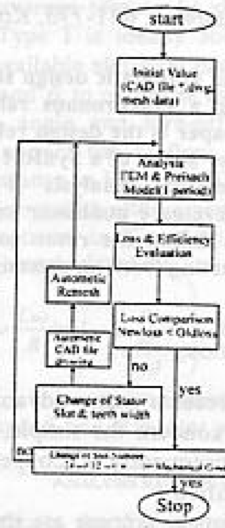
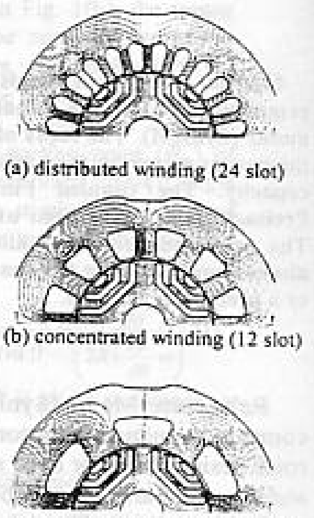


Fig.1 flow chart of design procedure



(a) distributed winding (24 slot)
(b) concentrated winding (12 slot)
(c) concentrated winding (6 slot)

Fig. 2 d-axis flux plots of distributed and concentrated winding SynRM

And the number 24, 12, and 6 of stator slot is considered, because it is limited by mechanical and electrical constraint of 3 phase motor.

The shape coordinates of stator slot and teeth have been drawn as a condition from open to closed slot, symmetrically.

And then new CAD file is redrawn with regard to the change of slot and teeth width automatically as shown in fig.1.

Next the process of automatic mesh generation follows.

The comparison between present value and the past one for loss and efficiency evaluation are performed. And if past value is larger than the present one, number of slot will be changed.

This procedure is going on until the moment mechanical constraint of machine is reached. Through the more detailed analysis and experiment, the variable comparisons for performance of the SynRMs will be represented in next extended version

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The Eleventh Biennial IEEE Conference on Electromagnetic Field Computation

CEFC 2004

Digest Book

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