DQ03

Development of a Coil Arrangement Method in the Design of Multiphase and Multipole Motor

Dong Sok Kim[1]*, Il Hwan Park[1], Gwan Soo Park[1], and Hong Soon Choi[2]

[1]School of Electrical Engineering, Pusan National University, Busan 609-735, South Korea

[2]School of Electronic & Electrical Engineering, Kyungpook National University, Gyeongbuk 742-711, South Korea

*Corresponding author: Dong Sok Kim (e-mail: kdongsok@pusan.ac.kr;
optional phone: +82-51-510-1488; optional fax: +81-51-513-0212)

The design of multiphase and multipole motor is very complicated because of huge number of slots and complex parameters in the design. To overcome these difficulties, we developed the CAM (Coil arrangement method) to determine the slot numbers and winding scheme in this thesis. A difference between electrical angle and phase winding has been calculated and the smallest difference is adopted in phase per slot. This method is very systematic and particular. Moreover, this method can discriminate fitness of designed winding. This method is applied to all combination (phase/pole/slot).

The proposed procedure of CAM winding method is as follows. Firstly, the electrical angel for each slot is calculated. Secondly, the permissible range of coil span (pitch), whisch represents an integer number of skipping slots of a coil bundle, is calculated. Thirdly, the phase angle and inverse phase angle of each phase is assigned. Fourthly, the difference of electric angle and phase angle per slot is calculated. Lastly, each slot connects to the phase which has the smallest phase difference calculated. We is applied to motor of various strurcture and analysised using FEM for the verification of this method.

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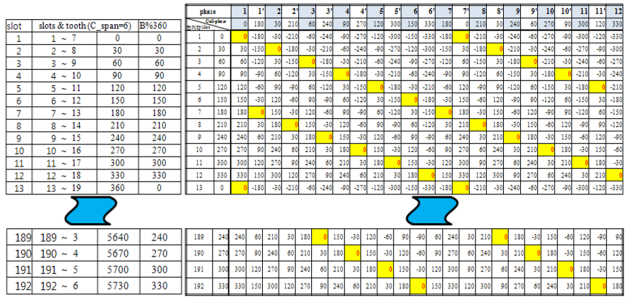

slot	slots & tooth (C_span=6)	B%360	
1	1 ~ 7	0	0
2	2 ~ 8	30	30
3	3 ~ 9	60	60
4	4 ~ 10	90	90
5	5 ~ 11	120	120
6	6 ~ 12	150	150
7	7 ~ 13	180	180
8	8 ~ 14	210	210
9	9 ~ 15	240	240
10	10 ~ 16	270	270
11	11 ~ 17	300	300
12	12 ~ 18	330	330
13	13 ~ 19	360	0
189	189 ~ 3	5640	240
190	190 ~ 4	5670	270
191	191 ~ 5	5700	300
192	192 ~ 6	5730	330

Fig. 1. Process of new coil arrangement method using electrical angle.

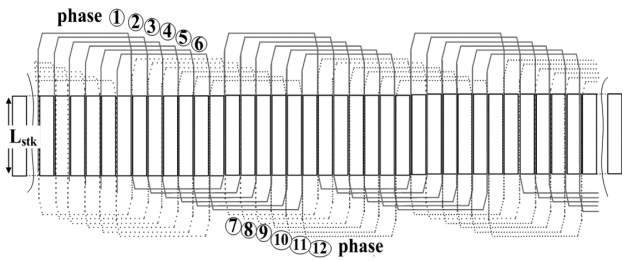

Fig. 2. Designed winding of multiphase and multipole model using new coil arrangement method.

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DQ04

A Study on the Design of an Inset Permanent Magnet Type Flux-Reversal Machine

Tae Heoung Kim*

Department of Electrical Engineering, Gyeongsang National University, Jinju, Gyeongnam 660-701, Korea

*Corresponding author: Tae Heoung Kim, e-mail: ktheoung@gnu.ac.kr

Flux reversal machines (FRMs) are doubly salient machines with permanent magnets on the stator. The permanent magnet flux linkage in the stator phase concentrated coils reverses polarity with the rotor traveling [1]. Its simple structure makes it cost effective and suitable for mass production. It has a low self and mutual inductances, hence a low electrical time constant and high fault tolerance. However, there is notable permanent magnet flux leakage (fringing) and cogging torque caused by its structure. This flux leakage deteriorates the torque constant of the FRM. The cogging torque also produces a pulsating torque ripple resulting in vibration and acoustic noise that is detrimental to the machine performance.

In this paper, we propose the new inset permanent magnet type FRM to reduce the flux leakage and cogging torque. Fig. 1 shows the constructed inset type FRM. This new type FRM has the permanent magnets parallel to the stator magnet flux lines and thus is much more difficult to demagnetize. As a bonus the flux fringing and cogging torque are notably small. The all experimental results are shown to confirm the validity of the proposed FRM in the full paper.

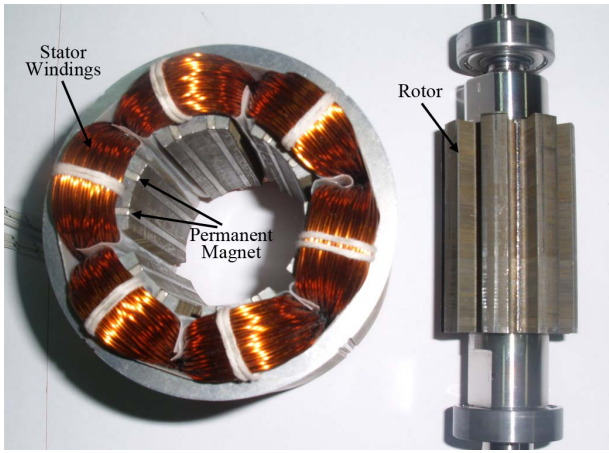

Fig. 1. The constructed inset type FRM.

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