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Book of abstracts



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Minimization of torque pulsation in slotted PM machines with magnetic wedges

Abstract. The paper presents chosen results of magnetic circuit in electrical machines with permanent magnets simulating research. In this circuit the magnetic wedges which close slots with windings have been provided. In analyzed structure of magnetic circuit first wedge's magnetic permeability have been changed and then electromagnetic torque value have been examined. Because of that assigning magnetic wedge's specific permeability was executed, for which a torque in given structure is possibly largest with minimal pulsations.

Keywords: magnetic wedge, permeability, torque pulsations, electromagnetic torque.

Introduction

The main source of electromagnetic torque pulsations in slotted electrical machines (SdEM) with permanent magnets it is very high difference between reluctance near slot and cog. The electromagnetic pulsations can be limited by decreasing cogging torque [1, 2]. A few methods of cogging torque elimination are known, but every common implemented ones cause lowering output electromagnetic torque.

In article the way of using magnetic wedges is proposed, in view of minimalizing electromagnetic torque pulsations.

Magnetic wedges implementation

Magnetic wedges used in SDEM perform double function:

1. mechanical – hold windings in slots,
2. magnetic – carry magnetic flux from rotor – this cause that grows the average value of magnetic flux density.

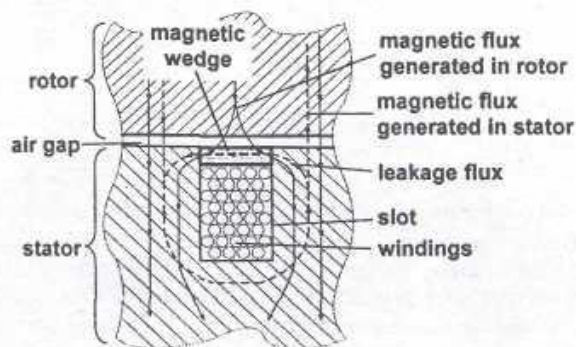


Fig.1. Slot with magnetic wedge

Unsuccessful effect of using magnetic wedges is lost a part of generated in windings magnetic flux due to its flow across this wedges [3]. This situation is illustrated in drawing figure 1, where is marked the leakage flux caused by magnetic wedges presence. According to above it is necessary to find out the optimal value of magnetic wedges' permeability, for which pulsations will be lowest but the electromagnetic torque possibly largest.

Model SdEM with magnetic wedges

The magnetic circuit of slotted cylindrical electrical machine shown in figure 2 has been an object of research. As a result of the investigation are magnetic flux density in air gap distributions shown in figure 3. These distributions present a magnetic flux density along one pole pitch in the middle of the air gap for several values of magnetic wedges' permeability.

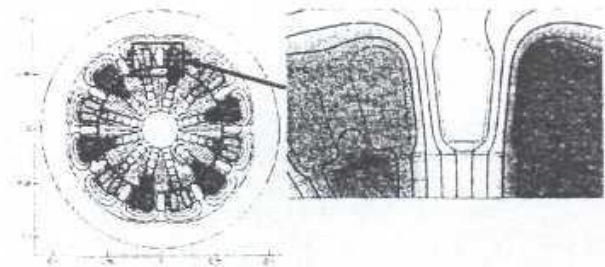


Fig.2. Structure of SLEM with magnetic wedges

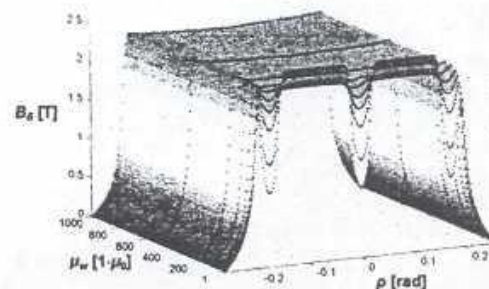


Fig.3. Magnetic flux density in air gap

Conclusion

It is concluded that when using magnetic wedges with an optimal value of magnetic permeability in slotted electrical machines with permanent magnets plenty of decreasing pulsations and at the same time increasing electromagnetic torque's value are caused. Unfortunately when the level of magnetic wedges' permeability is too high, then the electromagnetic torque can be significantly lower than in situation without magnetic wedges.

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