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THE HARMONIC FIELD EFFECTS IN SHADED-POLE INDUCTION MOTOR

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Despite its simplicity of construction, the shaded-pole induction motor (SPIM) is a difficult object for a theoretical analysis, because to this motor peculiar electric and magnetic asymmetric and considerable saturation of separate areas of iron core. Electric asymmetric of SPIM is due to a different number of turns, various cross-sections of turns of main winding and shading coil, by displacement of stators winding on a space angle less than 90 electric degrees, magnetic – predefined salient poles of stator core. Therefore the form of spatial distribution of magnetic induction curve in an air gap considerably differs from a sinusoid.

A mathematical model of SPIM and digital calculation of steady-states is described. The saturation of main magnetic flux is taken into account. The electromagnetic parameters are calculated on the base of ramified equivalent circuit of motor magnetic circuit. For the analysis, a d-q model of a generalized machine theory with two stator windings arranged in an arbitrary way in the stator is chosen. The conversion of the sguirrel-cage rotor into a equivalent two-phase winding is possible. It allows to work out four equations of the electric state. The mathematical model of SPIM allows to expect steady-states modes in this motor at non-linearity of descriptions of magnetizing of core and arbitrary time-history currents of winding and magnetic flux.

The differential harmonic method to calculation steady-states in SPIM has been considered. The problem is solved using a nonlinear programming technique. The way of problem solving when the slip are given is shown.

The offered mathematical model allows to get the integral distribution of magnetic field in the air gap of SPIM for any value of slip from s=0 to s=1 and to get its harmonic analysis.

The got distribution of magnetic field in the air gap of SPIM for starting mode, the critical slip and at the nominal loading. For these modes data of harmonic analysis of curves of the field $B\delta = f(\alpha)$ – absolute and relative values of main and high harmonics (3, 5, 7) are got. At the calculation of relative values of high harmonics for "unit" there is the accepted amplitude of the first harmonic.

Executed a harmonic analysis is confirmed by the improvement of curve of the field of SPIM in the nominal mode by comparison to the starting mode and with work at the critical slip.