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MATHEMATICAL MODEL OF ASYNCHRONOUS MOTOR TAKING INTO ACCOUNT ROTOR TEETH SKEW

Asynchronous motors are the basic consumers of electric energy in industry, agriculture and they are widely used to drive of most industrial mechanisms, that is why the research of processes in asynchronous motors by the mathematical modelling was always attentioned.

As known, in asynchronous motors the rotor teeth are skewed. Thus harmful influence of ultraharmonics diminishes on the curve of moment, electromagnetic vibrations and noises diminish, synchronous moments diminish.

Although a rotor teeth skew is widespread enough, on work of machine and her parameters attention not enough is spared research of his influence.

The conducted analysis of literature testifies that to taking into account of the rotor teeth skew on behavior of asynchronous motor in transients not paid attention practically, and most articles are sanctified to taking into account of additional losses or transversal currents of rotor.

The task of this research is development of mathematical model of asynchronous motor taking into account the rotor teeth skew, saturation of magnetic core and spatial harmonics of magnetomotive forces in their interconnection.

Asynchronous motor has an s windings on stator, distributed arbitrarily in slots along a period of the magnetic field and r bars on rotor, skewed on one teeth pitch.

In a basis of mathematical model the following assumptions are fixed:

1. Hysteresis and eddy currents are neglected.

2. The magnetic field is divided on mutually independent the main magnetic field and leakage fields.

3. The toothed structures of stator and rotor are replaced by homogeneous in tangential direction layers, which magnetization curve in radial direction is equivalent to the magnetization curve of real slotted zones.

4. The magnetic field in active layer has only radial component, in the stator and rotor yokes – only tangential one.

Will cross the magnetic core of motor with m planes perpendicular to the axis of rotation of rotor, considering unchanging distribution of the field in axial direction between two nearby planes.

With such assumptions the computation of magnetic field can be come to solving the one-dimensional two-point boundary problem. To solve this problem the method of trigonometric collocation has been used.

The system of algebraic-differential equations describing the electromechanical transients in the asynchronous motor contains the equations of magnetic state, the formulae of flux linkages and electromagnetic torque, the equations of electrical and mechanical states. The derivatives in this system of algebraic-differential equations are approximated according to the g-th order backward differentiation formula. The received linearized nonlinear system of algebraic equations is solved by the Newton method.

The worked out mathematical model of asynchronous motor with rotor teeth skew taking into account the magnetic core saturation and spatial harmonics of MMF allows to model behavior of motor in transients, steady-states, to carry out the estimation of influence of rotor teeth skew on static characteristics.