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MODELING THE WORK OF MULTIPHASE INDUCTION MOTORSIN DAMAGE EXPLOITATION REGIME

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Түйін

Апатты жұмыс режимі кезіндегі орамалардағы температураның артуын есептеуге мүмкіндік беретін, көпфазалы асинхронды қозғалтқыштың жылулық үрдісінің математикалық моделі ұсынылып, тәжірибелік түрде тексерілді.

Резюме

Предложена математическая модель тепловых процессов в многофазном асинхронном двигателе, которая позволяет рассчитатьпревышение температуры обмотки при аварийных режимах. Адекватностьмоделипроверенаэкспериментально.

Key words: multi-phase induction motors, electrical machines, stator, rotor, current, torque, mathematical model.

The aim of this work is to develop a mathematical model for the study of thermal fields of multi-phase induction motors in steady-state and emergency operating modes, which are accompanied by disconnection (open) phases (or single phase) in order to show the ability to work asynchronous machines as part of controlled electric drive without additional cooling.

Features of operation of electrical machines in the regulated electric and high vibration and noise, imposing certain requirements for the design, require a different approach in the design. At the same time, especially multi-phase motors make these machines suitable for use in variable speed drives for various purposes, and in the case of increased requirements for reliability and dynamic properties is almost the only possible vehicle due to the simplicity of their production, as multi-phase machine can be made on the basis of a three-phase induction motor. Multiphase machines are in practice ever-increasing use in a wide power range kW or less before MW.

The study of transient thermal processes for the high reliability of electric charge due to the fact that for these actuators can be impossible to immediate shutdown in the event of emergency operation (phase failure), and should continue to operate the machine for some time off without serious consequences. Thus, it is necessary to find out the length of operation of the machine at breakage phase (or phases) under the terms of the safe heating of the stator winding. It is also clear that the failure of one phase will allow to operate the machine for a longer time than open two phases, since the equal heat capacity parts of the engine increasing the heat (up current in the remaining phases) will lead to a rapid rise in temperature and the achievement of limiting the temperature at which you want to stop electric drive for troubleshooting.

The heat equation for two-dimensional thermal field represented in the form

$$\frac{\partial}{\partial x}(\lambda_x \frac{\partial T}{\partial x}) + \frac{\partial}{\partial x}(\lambda_y \frac{\partial T}{\partial y}) = -q - c\rho \frac{\partial T}{\partial t};$$

where T - the temperature; t - time; λ_x (y, z) - conductivity components q (T) - specific heat capacity; c - the specific heat; ρ- density of the material.

In order to make the calculation of the currents in the windings of the phases, it is necessary to make a calculation of the electromagnetic motor to determine the parameters of the machine with the specified nominal data. Then, the calculated program was drawn up in MathCAD environment in 2001 to determine the current and torque.

Background: P2n - nominal motor power kW; 2p - the number of poles; U1n - nominal phase voltage, V, m - number of phases of the motor; nн - synchronous speed, rev / min.

Options received as a result of electromagnetic calculation: r1 - active resistance of the stator winding, Ohm; r2 - The provided resistance of the rotor winding, Ohm; x1 - the inductive reactance of the stator winding, Ohm; x2 - The provided rotor winding resistance, Ohm; s - sliding.

Breakage any phase of the multiphase machine causes distortion of the magnetic field due to the fact that the phase fault in a three-phase group leads to the occurrence of the pulsating magnetic field that has a two-phase system. Following the procedure, it is possible to calculate the electromagnetic torque produced by this pulsed magnetic field on the symmetrical components of the decomposition current in the windings, since three-phase group of multiphase machines are similar to the design of three-phase machines.

For this we use the equation of the phase currents, self and mutual resistance of the individual phases, ohm:

$$\begin{cases} Z_\sigma = \frac{Z_+ + Z_-}{3}; Z_\alpha = \frac{ej_+Z_+ + ej_-Z_-}{3}; \\ Z_\beta = \frac{ej_+Z_- + ej_-Z_+}{3}. \end{cases}$$

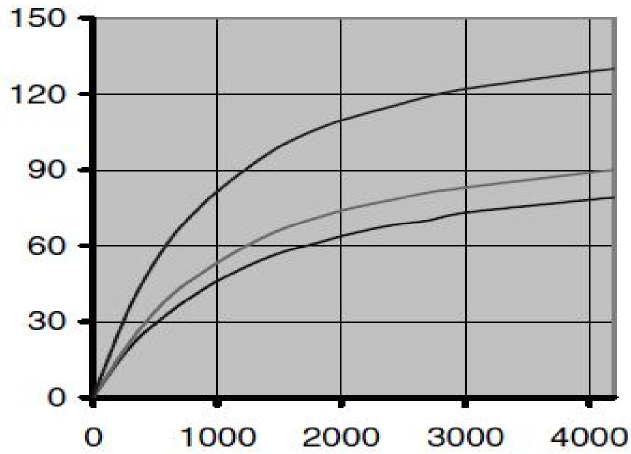
$$\begin{cases} Z_+ = \frac{1}{\frac{1}{Z_{2s+}} + \frac{1}{jx_m}}; Z_- = \frac{1}{\frac{1}{Z_{2s-}} + \frac{1}{jx_m}}; \\ Z_{2s+} = \frac{r_2^1}{s} + jx_2^1; Z_{2s-} = \frac{r_2^1}{2-s} + jx_2^1. \end{cases}$$

$$M = \frac{m_1 p}{2\pi f}(I_+^2 r_+ - I_-^2 r_-), \quad \text{Н} \cdot \text{м},$$

$$I_A = -I_B = \frac{U_1}{Z_{1AA} + Z_{1BB} + Z_{BB} - Z_{AB} - Z_{BA}}, \text{ A.}$$

As a result of the simulation graphs of transient thermal processes in time. For example, a graph is given a non-stationary heating of a multiphase induction motor is 5.5 kW.

MULTIPHASE INDUCTION MOTOR IS 5.5 kW



Time,s

Table. The duration of the engines

Power kW	3.0	4.0	5.5	7.5
At breakage phase1, min	unlimited	unlimited	unlimited	unlimited
At breakage phase2, min	19	15	24	9

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