STUDY OF MINIMUM CURRENT WORKING MODES OF ASYNCHRONOUS MOTOR

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If we take into account that the magnetic flux is connected with the stator winding voltage through a nonlinear coefficient, then we differentiate the expression in the form of the ratio of the stator current corresponding to the nominal operating mode to the nominal value and make it equal to zero by differentiating the magnetic flux change:

$$\frac{d\left(\frac{I_1}{I_{1_H}}\right)}{d\phi} = 0 \qquad (1)$$

where I_1, I_{1_H} − the actual and nominal values of the stator current at the corresponding stage;

$\phi = \frac{\Phi_1}{\Phi_{1_H}}$ − is the relative value of the magnetic flux between the stator and rotor of the asynchronous motor, Φ_1 and Φ_{1_H} are the actual and nominal values of the magnetic flux, respectively.

As a result of the increase in the magnetic flux, the decrease in the active component of the stator current leads to a decrease in the total value of the stator current. At a certain value of the magnetic flux, the stator current operates in the minimum value mode, and the implementation of this mode is based on the fulfillment of the condition (1).

Figure 1 shows the description of the change of the asynchronous motor stator current depending on the magnetic flux when the speed is adjusted by changing the relative value of the frequency in the range of $\alpha = 0{,}2 - 1{,}0$ when the load moment is m_$\mu_c = 1{,}0$ When the asynchronous motor operates at the rated frequency and rated load, the value of the magnetic flux $\phi = 1{,}2$ ensures the minimum stator current. As the value of the frequency decreases, the minimum point of the description of the stator current moves towards the direction of the decrease of the magnetic flux. For example, when $\alpha = 0{,}2$, the minimum value of the stator current corresponds to the value of the magnetic flux $\phi = 0{,}22$.

The analysis of the descriptions shows that when the speed of an asynchronous motor is adjusted by changing the frequency at the nominal load moment, the magnetic system of the motor is saturated when the frequency value is $\alpha = 0.8$ and $\alpha = 1.0$, and in order for the stator current to be minimal, it is necessary to adjust the voltage supplied to the stator coil above the nominal value.

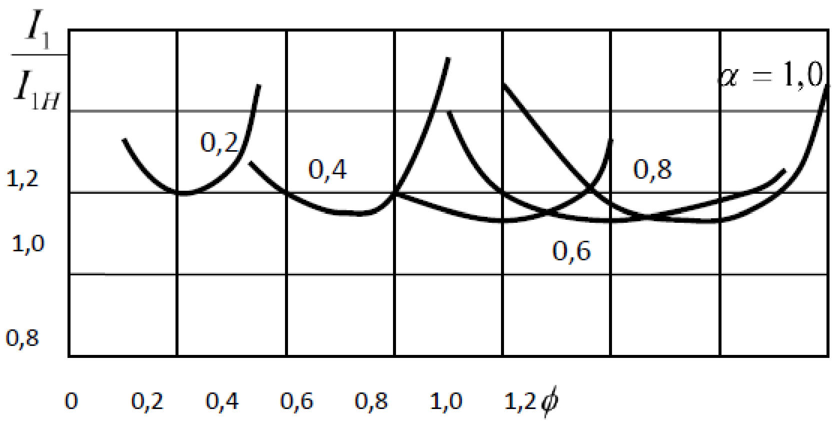

Figure 1. Characteristics of changes in the stator current depending on the magnetic field when the load moment on the axis of the 4A100L4U3 asynchronous motor is equal to $\mu_c = 1,0$ and its speed is adjusted in the range of the frequency change $\alpha = 0,2 - 1,0$

Figure 2 shows the description of the change of the stator current depending on the magnetic flux when the speed is adjusted by changing the relative value of the frequency in the range of $\alpha = 0,2 - 1,0$ when the load moment is $\mu_c = 0,8$ When an asynchronous motor operates at a frequency value of $\alpha = 1,0$ the magnetic flux at the value of $\phi = 1,15$ ensures that the stator current is minimal and the magnetic system of the motor is saturated.

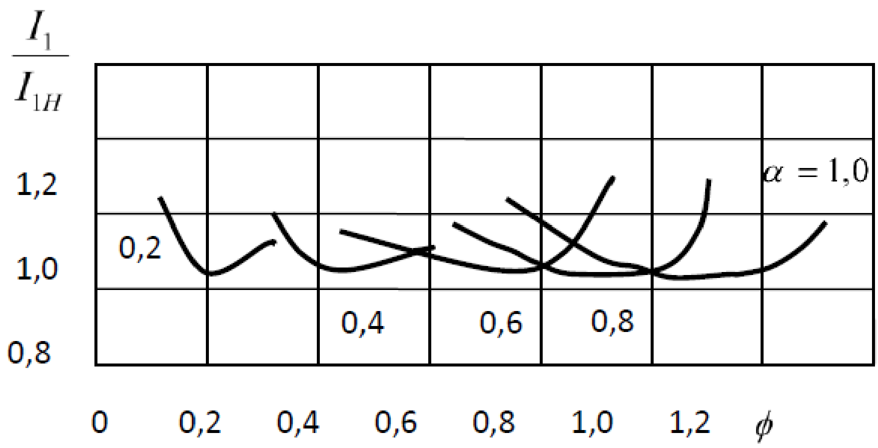

Figure 2. Descriptions of changes in the stator current depending on the magnetic field when the speed of the 4A100L4U3 asynchronous motor is adjusted in the range of frequency variation $\alpha = 0,2 - 1,0$ when the load moment is equal to $\mu_c = 0,8$

At other values of the frequency, that is, as the frequency decreases from the nominal value, the minimum points of the characteristics of the stator current shift towards the direction of the decrease of the magnetic flux, and the magnetic system of the motor is unsaturated. For example, when $\alpha = 0{,}2$ the minimum value of the stator current corresponds to the value of the magnetic flux $\phi = 0{,}21$.