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Analysis of Operations and Restoration Description of ASYNCHRONOUS MOTOR

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ABSTRACT: The analysis examined the optimal performance of an induction motor, which can be adjusted by changing the frequency and speed.

KEYWORDS: induction motor, frequency, magnetization current, electric current, static torque, stand-alone current converter.

I.INTRODUCTION

Let us consider an analysis of the characteristics of induction motors for loads characterized by constant static torque $M_S = M_N$ = const at normal and optimal (energy-saving) currents operating in variable frequency drive electric circuits. Performance and adjustment characteristics for the 4A series induction motor with a voltage range of 0.6-15 kW, for harmonics k = 1, with an adjustable electrode with an adjustable speed. Given the almost identical results for different capacities, we give below descriptions for one brand of induction motors (4A80B4U3), built into relative units. In this case, the main values are the rated currents of the stator and rotor, magnetic current, sliding, electromagnetic and cumulative losses, power factors and efficiency, as well as their multiples φ = 1 and m = 1.

II. SIGNIFICANCE OF THE SYSTEM

Figure 1. shows the current performance of an induction motor at a frequency of F=1 in an electrolytic system with a frequency converter. Stator current I_S, magnetic current I_0 and rotor current are equal to the geometrical value $I`_R$; the rotor current is inversely proportional to the current and therefore decreases with increasing φ.

Therefore, the I_S connection with the flow is nonlinear and elastic. Power loss: Electromagnetic ΔP_E and accumulated $\sum\Delta P$; and also the power required by the P_T network will have a similar shape in the function φ. Power losses are the limit when the dispersion of the charging voltage and the magnitude of the alternating current through the magnetic flux are equal. Please note that when the control frequency changes, the stator current will remain constant, while the limiting power losses will be changed to a value corresponding to the nominal frequency (when the frequency decreases or increases, it moves left or right).

As the magnetic current increases, the speed of the induction motor slightly increases, which leads to a decrease in slip C and an increase in useful power. Therefore, the minimum power required by the network corresponds to the lowest value of the magnetic flux compared to the minimum value of the loss of electromagnetic power. Characteristics of electromagnetic indicators: Efficiency η, power factor cosφ and their multiplication η·cosφ reach a maximum at a given current value. The efficiency reaches its maximum value when the variable power losses and voltage losses are equal. The power factor increases and reaches its maximum at low current values, and when the current increases, the stator current decreases significantly as a result of a decrease in the active component and the increase current.

The maximum value of power (η · cosφ) corresponds to a lower value of magnetic flux than the maximum value of η (cosφ = 0.93): the magnetic flux of an induction motor in an electric circulation system. The adjustment parameters for nominal φ = 1 (solid lines 1) and optimal $\varphi = \varphi_{opt}$ (dashed lines 2) are shown in Figure 2. The optimal value of the magnetic current corresponds to the minimum power loss in this motor.

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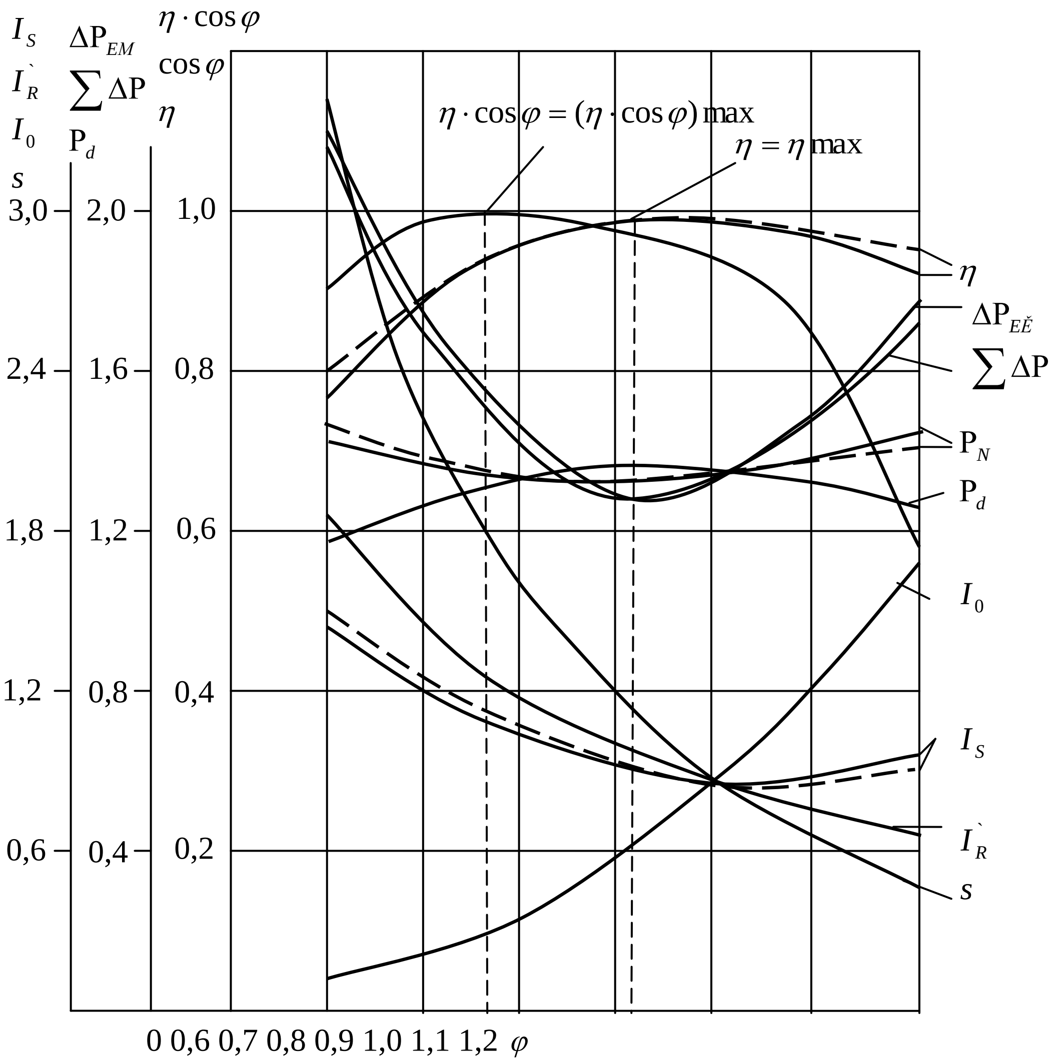

Chart 1. Characterization of the change in the magnetic current of electrical and energy parameters at a frequency equal to F = 1 of the 4A induction motor with speed control.

III. LITERATURE SURVEY

Figure 2 shows that with an increase in the stator current with I_S, mainly due to an increase in power losses on the axis of the induction motor, the speed of the induction motor increases with increasing F, at which the powers P_d and P_n change, and gliding occurs according to a hyperbolic law. For φ = 1 and $\varphi = \varphi_{opt}$, the capacitances P_d and P_n do not change. For a type 4A induction motor in the entire frequency range (F = 0.2 - 1.4), these values are less in the optimal mode than in the φ = 1 mode (Figure 2). This is, firstly, the power increases with increasing φ, and secondly, the range of variation for these engines is mainly φ_{opt} <1. The power factor decreases with increasing frequency (Fig. 2), since the actual voltage is proportional to the frequency, and the required voltage does not change. In the optimal mode, when the frequency value decreases, the power factor cosφ initially decreases by increasing the optimal current value and decreasing P_p, which then increases as a result of a larger voltage drop. The efficiency increases with increasing frequency (Fig. 2), because the useful power of an induction motor is proportional to the change in F when $M_S = M_N$ = const, in contrast to P_n.

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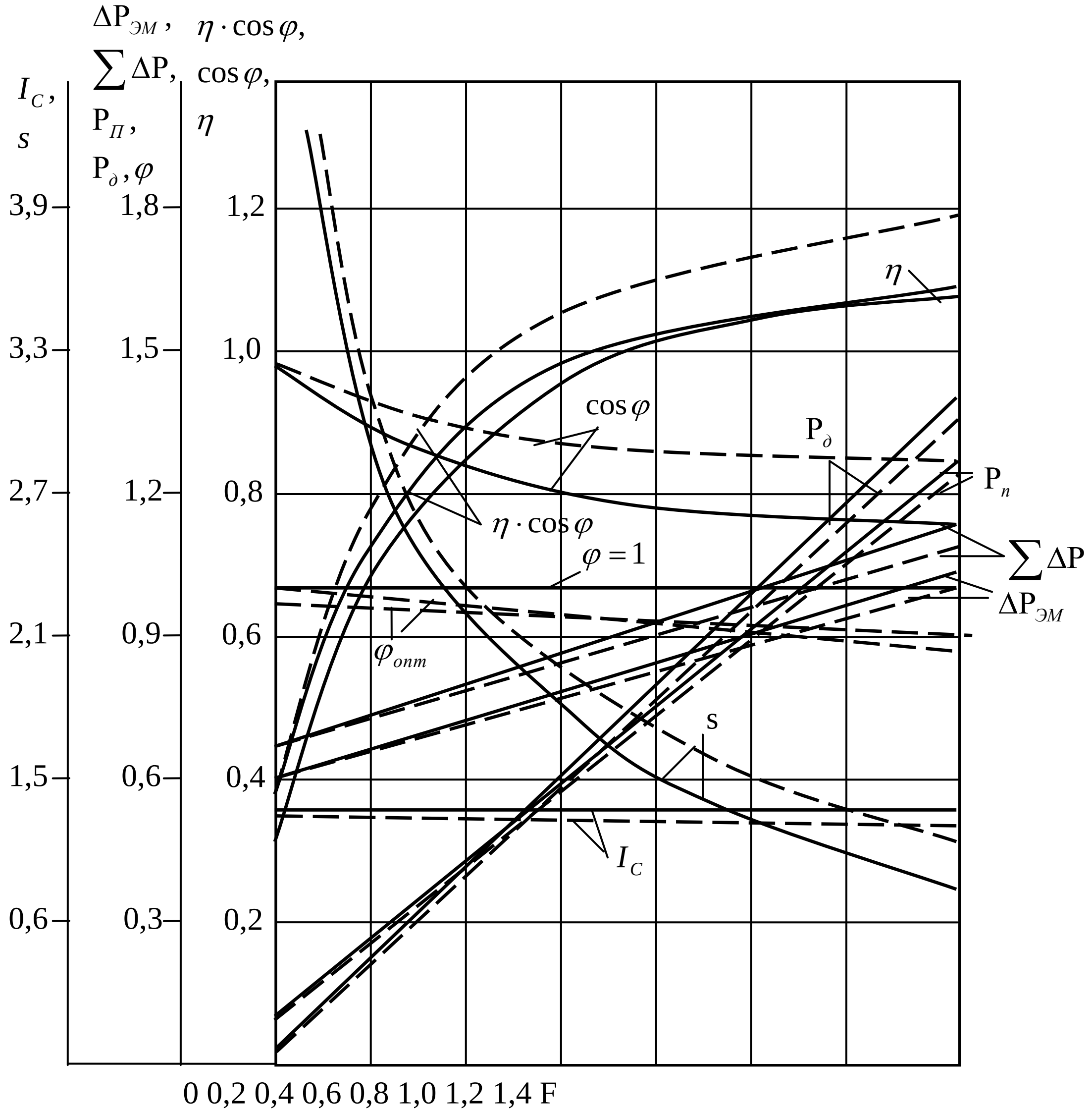

Chart 2. Characteristics of the frequency change in the nominal and optimal values of the magnetic flux of the parameters of a 4A induction motor with variable speed control.

IV. METHODOLOGY

The power loss of an induction motor operating in a variable frequency drive system is greater than the efficiency at φ = 1 in the optimal mode $\varphi = \varphi_{opt}$. The frequency tuning range in type 4A induction motors is 0.25 - 0.56% higher than the efficiency at φ = 1, when the optimal mode is F = 1.0 - 1.4 (Figure 2). For type 4A induction motors with decreasing frequency, the value $\varphi = \varphi_{opt}$ converges. Therefore, when the frequency is low (low), $\varphi = \varphi_{opt}$, the efficiency is slightly less than φ = 1. For example, the frequency value F = 0.6 - 0.2 is less than n = 0.04.
For engines of type 4A, the frequency adjustment range for $\varphi = \varphi_{opt}$ is F = 0.2–1.4. The following motor values exceed φ = 1 (Figure 2): power factor 0.7–7, 9%; The energy indicator is η · cosφ = 0.1-6.6%, since the rated power for 4A induction motors in frequency-controlled electrolytic systems increases with increasing F. The flux values of φ = 1 and $\varphi = \varphi_{opt}$ depending on the control frequency are also are shown in Figure 2. At the same time, the optimal consumption of an induction motor in an electrolytic system, which changes the frequency and is regulated, decreases with respect to the flux value φ.

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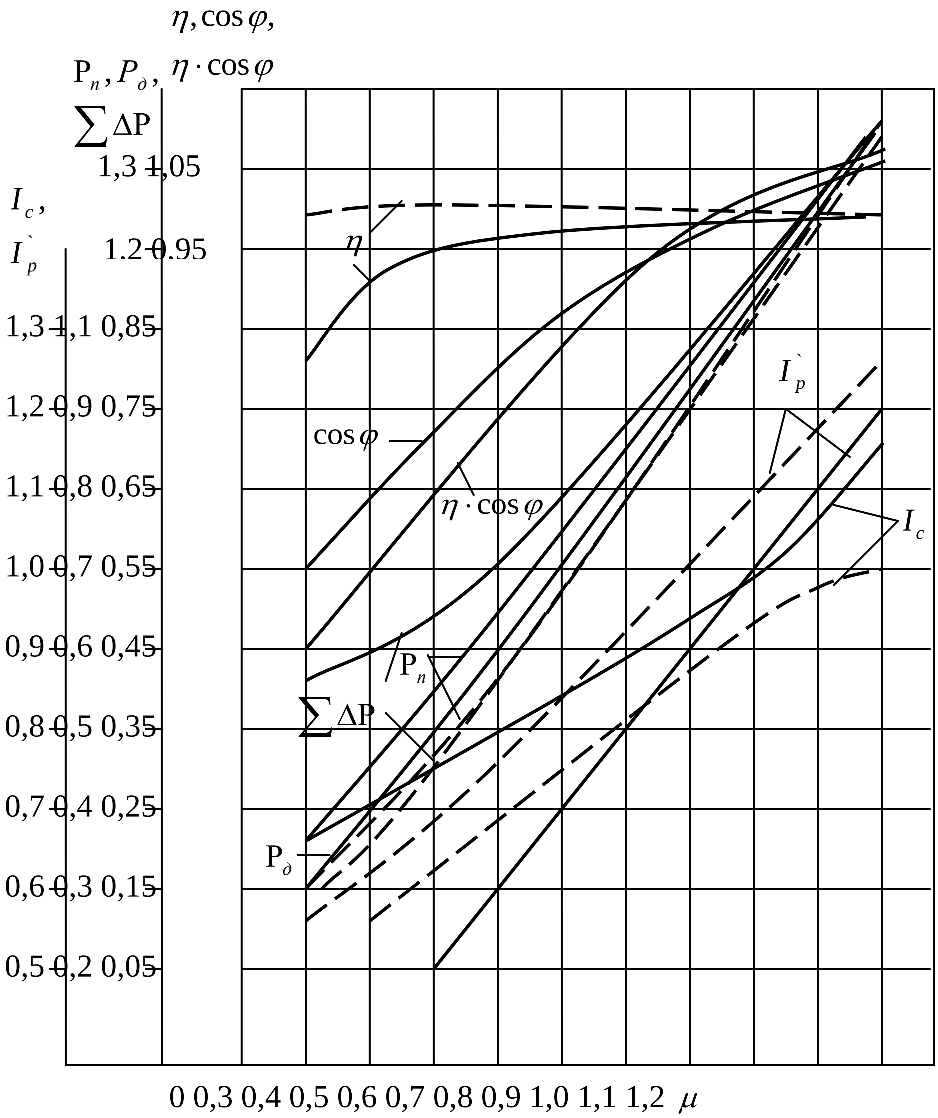
Figure 3 shows the operating characteristics (solid and dashed lines, respectively) of the magnetic flux of a 4A induction motor.

As the load increases, the current supplied by the rotor grows in a straight line. The stator current increases as a result of its component growth.

With an increase in the rotor and stator currents, the required power P_n and the total dissipated power $\sum\Delta P$, as well as with an increase in the load, also increase the power factor due to an increase in the active component of the motor current and an increase in active power. When the load is small, the net power P_d changes almost in a straight line, and the required power increases slowly. Therefore, at a given load, the efficiency reaches its maximum value, and with increasing load, its value decreases.



Schedule 3. Dependence of the load on the nominal and optimal values of the magnetic flux of the 4A induction motor in a frequency-controlled electric drive system.

Figure 3. shows the change in the studied values in the optimal mode $\varphi = \varphi_{opt}$ than in the mode $\varphi = 1$. For example, for model 4A, the stator current decreases by 2.1-2.9% when the load changes from μ 0.3 to 1, 2; total power consumption - 26.5 - 2.9%; required power reduced from 7.7 to 2.0%; In this range of load changes increases: I_R` - by 24.6 - 6.1%; η - 17.3 - 0.4%; cosφ - 57.3 - 6.6%; η · cosφ - 66.7 - 7.7%.

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Automatic maintenance of the optimal current value and control actions corresponding to its level allows to ensure the minimum mode of power dissipation in the motor, which increases the energy and performance of a frequency-regulated power source [4]. The analysis shows that in an induction motor with a wide range of frequency changes, when power consumption is controlled with the least power, its temperature rise is also the smallest, its absolute value is below the permissible temperature. Thus, the automatic maintenance of the optimal magnetic flux at which the total power dissipation in the engine is the minimum power, in turn, ensures that the motor overheating is minimized, which not only reduces the useful power factor. This also allows you to increase reserves (Figure 3).

The proximity of the calculated descriptions to the experimental data (Figures 1 and 2, solid and dashed lines) fully confirmed the results obtained on the basis of theoretical analysis, and the accuracy of the calculation method. The experimental data obtained in a stand-alone current converter of a current frequency converter - an asynchronous motor system - differ slightly from the calculated data, due to the influence of high harmonics on the motor power characteristics.

The above theoretical cases and laws of variation of the main quantities, including the change in the optimal current depending on the frequency and load, form special requirements for the automatic control and tuning of electric drive systems that provide an energy-saving mode.

REFERENCES

[1] Khoshimov O.O., Imomnazarov A.T. Energy Saving in Electromechanical Systems (Textbook). T., 2015, 164 p.

[2] Imomnazarov AT, Azamova GA, Energy-saving modes of an induction motor. Tashkent, Tashkent State Technical University, 2014.140 s.

[3] Imomnazarov A.T. Elements of electromechanical systems. Textbook for high schools. - Tashkent: “Education”, 2009.155 s.

[4] Khoshimov O.O., Imomnazarov A.T. Energy saving in electromechanical systems. Textbook for high schools. - Tashkent, UAZhBNT Center, 2004, 96 p.