DEFINITION OF A STATOR WINDING INDUCTANCE OF INDUCTION MOTOR

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External characteristic of an induction machine as generator and motor depends of its parameters. Therefore the exact value of a stator winding inductance is very important. Along with a flux of the fundamental harmonic (the main magnetic flux of mutual induction) currents of stator and rotor create a leakage flux defining the components values of windings inductance.

The inductance of a stator winding

$X_1 = X_{gd} + X_{ecd} + \tau_\sigma X_\mu$,

where X_{gd} is the grooving dissipation inductance, X_{ecd} is the end coil dissipation inductance, $\tau_\sigma X_\mu$ is the differential dissipation inductance, X_μ is the mutual induction inductance.

The coefficient of mutual induction for the fundamental harmonic

$M = \dfrac{\mu_0 D l m w^2 k_w}{\delta k_\delta k_\mu \pi p^2}$, where μ_0 is the permeability of vacuum, D is the diameter, l is the length of a stator, m is the number of phases, w is the number of turns, k_w is the coefficient of winding, δ is the length of air gap, k_δ is the coefficient of air gap taking into account a conditional extend as a result of stepped appearance surface of a stator and rotor, k_μ is the coefficient of saturation of a magnetic circuit, p is the number of poles pairs.

The empirical coefficient is for a single-layer stator winding with the width of grooving b_n and the height h_n

$$\lambda_n = \frac{h_n}{3b_n}$$

The empirical coefficient is for a two-layer stator winding

$\lambda_n = \dfrac{h_n}{3b_n} \cdot \dfrac{3\beta + 1}{4}$, β is the degree of a pitch shortening

Thus the inductance of a single-layer stator winding is

$$X_1 = 4\pi f \mu_0 \frac{w^2}{p}\left[\frac{l}{q} + \left(0{,}67 l_{ecd} - 0{,}43\frac{\pi D}{2p}\right)\right] + \tau_\sigma X_\mu$$

f is the voltage frequency,

and the inductance of a two-layer stator winding is

$$X_1 = 4\pi f \mu_0 \frac{w^2}{p}\left(\frac{l}{q} \cdot \frac{3\beta + 1}{4} + 0{,}57\frac{3\beta - 1}{2}\frac{\pi D}{2p}\right) + \tau_\sigma X_\mu .$$

Literature:

1. Bogatyrev N.I. Shemy statornykh obmotok, parametry i kharakteristiki elektricheskikh mashin peremennogo toka. – Krasnodar, 2007. – 301.