Universal magnetic flux characteristics in a shell-type transformer.

Shakirov M. A., Tkachuk A. A.

It is shown that in a real shell-type transformer, in contrast to idealized one with infinite permeability a F-quasi-invariant surface takes place in the primary winding. This surface covers the magnetic flux, which is almost unchanged under load variations. Strict f-invariance is observed only in their middle parts, i.e. at the intersection of these surfaces with the plane of symmetry of the transformer. This explains the arachnid character of the family of magnetic flux curves corresponding to different loads. Their universality is manifested in the fact that they do not depend on the number of turns of the windings and, consequently, on the transformation ratio. The shape of the family is determined solely by the geometry of the windings and the magnetic circuit, as well as which of the windings, internal or external, is primary. The arachnology of the family clearly explains the difference in the magnitude of the fluxes of the rod and lateral bore in the working mode and the phenomenon of the emergence of super- and anti-fluxes (in comparison with the no-load flow) in these places during short circuits. The validity of the physical and mathematical ideas underlying the 4T-shaped equivalent circuit is confirmed, as is the model that most fully reflects the listed properties of the magnetic flux in the transformer. The results obtained are important for a correct understanding of the shell-type transformers workflow, as well as for the improvement of their design methods.

Keywords: transformer, primary and secondary windings, magnetic flux, equivalent circuit, short circuit, no-load, flux function.