ENERGY PROCESSES IN A LINEAR PULSE ELECTROMECHANICAL CONVERTER

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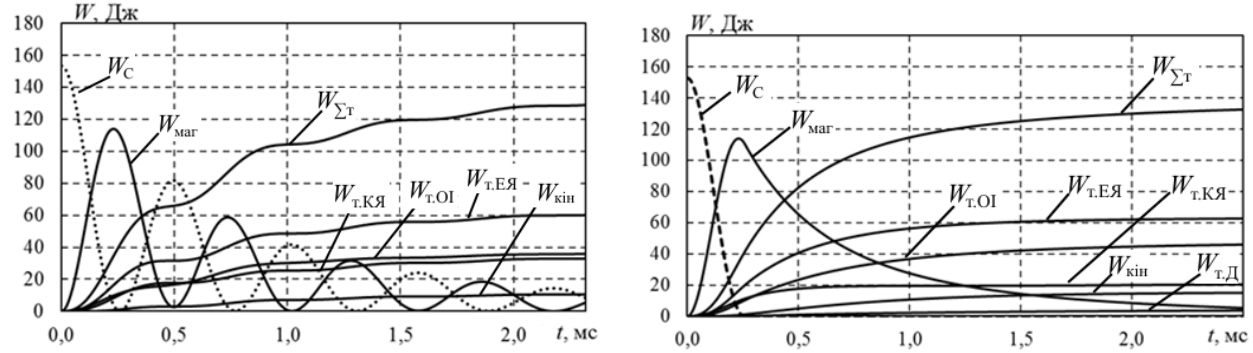
A mathematical model has been developed for a linear pulsed electro-mechanical converter (LPEC), which includes a stationary inductor winding (IW), a ferromagnetic shield (FS), a movable coil armature (CA) and a massive electrically conductive armature (ECA). To implement the mathematical model, a system of partial differential equations with respect to spatial and temporal variables is used in the Somsol Multiphysics software package. The model used a grid of the type "Free triangular" with the size of the elements "Extra fine". The relative displacement of the elements of LIEP led to the use of automatic restructuring of the grid Automatic remeshing (criterion of restructuring the grid mod1.fsi.minqual> 0,2). For each of the physical modules ("Magnetic fields", "Electrical circuit", "Heat transfer in solid"), a solution interpolation for individual finite elements was used, which is determined by quadratic or cubic sampling. Fig. 1 shows the energy processes in LIEP at oscillating-attenuating (a) and aperiodic (b) pulses of the excitation current.



a *b*

Fig. 1

To check the energy balance during the LIEP workflow, the relative error is calculated $\delta_W = 100 \cdot (W_0 - W) \cdot W_0^{-1}$,%, where W_0=0,5$C_0U_0^2$ – initial energy of capacitive energy storage; $W = W_c + W_{\Sigma T} + W_{маг} + W_{кін}$ – total energy; $W_{\Sigma T} = W_{т.ОІ} + W_{т.ЕЯ} + W_{т.КЯ}$ – total thermal energy; W_c, $W_{маг}$, $W_{кін}$, $W_{т.ОІ}$, $W_{т.КЯ}$, $W_{т.ЕЯ}$ – energy of capacitive energy storage, magnetic field, kinetic, thermal in IW, CA, ECA respectively.

With an oscillating-attenuating pulse of the excitation current, the maximum relative error δ_W = 0.04% occurs when the energy of the magnetic field $W_{маг}$ takes the minimum value. The aperiodic form of the excitation current is provided by a reverse diode *VD*, which is installed in parallel with the IW. In fig. 1,b in addition to the above components of the energy process is presented and thermal energy in the reverse diode $W_{тД}$. The relative error begins to increase after the voltage in the capacitive energy storage reaches zero and increases to δ_W = 0.18%.