

INFLUENCE OF PULSE EXCITATION ON ELECTROMECHANICAL INDICATORS OF A LINEAR PULSE CONVERTER OF ELECTRODYNAMIC TYPE

Bolyukh V.F., Kashanskyi Y.V., Shchukin I.S.

National Technical University

«Kharkiv Polytechnic Institute», Kharkiv

Linear pulse converters provide a high speed of the actuator movement in a short active section, and / or powerful power (shock-mechanical) pulses on the target. One of the promising ones is a linear pulse electrodynamic type converter (LPEC), the windings of which are excited from a capacitive energy storage device (CES) [8]. Converters of electrodynamic type, in spite of a more complex design, have higher electromechanical indices in comparison with converters of induction and electromagnetic types

Purpose. Investigation of the effect achieved by the electronic circuit-controlled inductor and armature windings pulsed excitation, powered with the capacitive energy storage (CES) source, on the speed and power indicators of a linear pulse electrodynamic type converter (LPEC).

On the basis of the developed numerical model, the influence of pulsed excitation — vibrationally damped, half-wave, aperiodic, and aperiodic with recharge, on the characteristics and performance of LPEC is studied. The mathematical model of LPEC, using the lumped parameters of the stationary winding of the inductor and the movable winding of the armature, takes into account the interconnected electromagnetic, mechanical and thermal processes, presenting their solutions in a recursive form.

It was found that the pulse excitation of LPEC insignificantly affects the maximum speed, the pulse of electrodynamic forces (EDF) and the temperature rise of the inductor winding. The highest values of the maximum speed and impulse of an EDF arise upon excitation by a vibrationally damped current pulse, and the smallest ones upon excitation by an aperiodic pulse. The excitation of LPEC by an aperiodic current pulse with recharge allows the use of a reduced charge voltage for rechargeable CES. With a decrease in this voltage and with conservation of the energy of the CES, the amplitude of the EDF decreases by 31.5%, but due to the delay of electromagnetic processes, the pulse of the EDF increases by 3%, and the efficiency - by 8.2%.

A comprehensive criterion for the efficiency of LPEC was introduced, which takes into account the amplitude of the excitation current, the mass of the windings, the temperature of the inductor winding, the magnitude of the EDF pulse, the efficiency, and the maximum speed for a given reliability coefficient. Using this criterion, it was found that in terms of power and speed indicators, the most efficient is a converter excited by an aperiodic current pulse with recharge, and the quality of work is a converter excited by an aperiodic pulse.

The influence of the width of the copper bus and the corresponding axial heights of the windings of the inductor and the armature on the speed and power performance of LPEC using vibration-damping, half-wave, aperiodic and aperiodic with recharge current pulses is established.