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Equivalent electrical circuit of superconductors in accordance with a two-fluid model at alternating currents

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The paper considers transient processes in superconductors that occur when a key is closed (or opened) in an electrical circuit at direct current, as well as processes with a sinusoidal change in the electromotive force (EMF) of a current source. To describe transients, an equivalent electrical circuit of superconductors is presented in accordance with a two–fluid model, according to which all electrons in a superconductor are divided into two types – superconducting and normal. At the same time, inertial inductances were introduced for the first time for superconducting and normal electrons L_s and L_n characterizing the dynamics of acceleration of various types of electrons due to the excitation of an electric field under variable conditions, as well as effective resistance to describe energy dissipation when normal electrons are excited. The dependences of the normal and superconducting currents and the electric field in superconductors on the frequency of the EMF of the current source are obtained, the average power of the current source and heat generation due to Joule losses in the superconductor during excitation of normal electrons depending on frequency and temperature are calculated.

Keywords: superconductivity, high-temperature superconductivity, HTS, two-fluid model, normal electrons, superconducting electrons, alternating current, equivalent electrical circuit, inertial inductances for superconducting and normal electrons.

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