New type of contact potential difference

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Abstract

The contact potential difference this is the potential difference, which appears between the located in the electrical contact conductors under the thermodynamic equilibrium conditions. Between two conductors, led to the contact, occur the electron transfer, as a result of which they are charged (conductor with the smaller work function positively, and with larger - negatively) until electron streams in both directions are balanced also in the entire system the level of electrochemical potential (Fermi level) becomes identical. The established contact potential difference is equal to difference the work function of conductors, referred to the electron charge. But from the attention of researchers slipped off still one type of contact potential difference, which occurs with the flow of the current through the superconductors. This type of contact potential difference is examined in this article

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But from the attention of researchers slipped off still one type of contact potential difference, which occurs with the flow of the current through the superconductors. The amount of the ponderomotive force gradient, which acts on the single square of the surface of conductor is determined by the relationship

$$F_{\square} = \frac{1}{2}\mu_0 H^2,$$

where H - magnetic field on the surface of conductor, μ_0 - magnetic permeability.

The magnetic field on its surface of superconductor, equal to specific current, can be determined from the relationship

$$H = nev\lambda,$$

where $\lambda = \sqrt{\frac{m}{ne^2\mu}}$ - depth of penetration of magnetic field into the superconductor.

Using these relationships easy to see that the specific ponderomotive force is equal to specific kinetic energy of the electrons

$$F_{\square} = \frac{nmv^2}{2}.$$

This force is applied to the moving electrons and attempts to press electronic flux. In order to balance the force indicated, near the surface of superconductor is formed the layer of the positively charged lattice (Fig. 1)

Depleted by electrons, whose electrostatic field balances ponderomotoruyu force. The thickness of this layer is proportional to the square of the electron velocity, and, therefore, also to the square of the current, which flows through the superconductor.

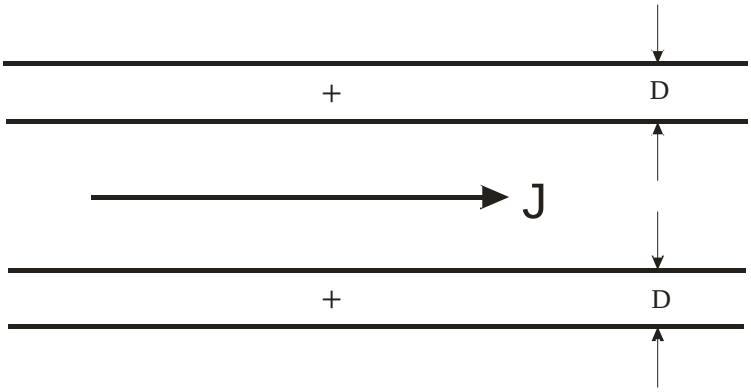

Fig.1.

If the superconductor, along which flows the current, to lead into the contact with the normal metal, then the part of the electrons from this metal will pass to depletion layer and between the superconductor and the normal metal is formed the contact potential difference, which is proportional to the square of current.

The contact potential difference comprises for the case of round conductor

$$\Delta\varphi = \frac{\mu_0 I^2}{(\pi d)^2 en},$$

where I - current in the wire, d - diameter of wire, e - electron charge, n - electron density.