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On the Thermodynamical Theory of Thermal Conduction of Dielectrics Under Electric Fields.

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In a recent paper [1], by means of the methods of the thermodynamical theory of irreversible processes [2], the following expression has been derived for the thermal conductivity of dielectrics in the presence of a longitudinal electric field:

$$k = k_0 + \frac{(\sigma - \sigma_0)\theta}{(\theta_s - \theta)^2} V^2 . \tag{1}$$

The conclusions drawn by the author, that k does not depend on the sign of the field and that the dependence of k on V is quadratic, however do not hold since $\Delta\sigma \equiv \sigma - \sigma_0$ depends on the relative orientation of thermal and electrical potential gradients. Indeed from the phenomenological equations it follows:

$$\Delta\sigma\,(V, \operatorname{grad}\theta) = -\,\Delta\sigma\,(-V, \operatorname{grad}\theta) = L_{12}\frac{\theta_s - \theta}{\theta V}, \tag{2}$$

hence, from (1)

$$\Delta k\,(V, \operatorname{grad}\theta) = -\,\Delta k\,(-V, \operatorname{grad}\theta) = L_{12}\frac{V}{\theta_s - \theta}, \tag{3}$$

(see Fig. 1 and 2).

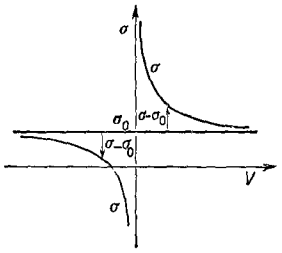

Fig. 1.

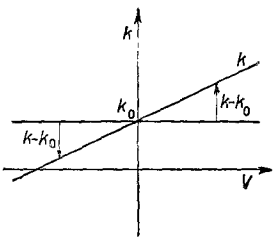

Fig. 2.

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(1) S. MASCARENHAS *Nuovo Cimento*, **5**, 1118 (1957).
(2) See, for instance, S. R. DE GROOT: *Thermodynamics of Irreversible Processes* (Amsterdam, 1951).