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*In the calculation of parameter η, the following values were used. $R_0 = 63$ cm-sec-deg-cal^{-1}; $C_v = 0.42$ cal-cm^{-3}; $\bar{v} = 3.2 \times 10^5$ cm-sec^{-1}; $N = cN_0$, where c is the molar concentration of the impurity, $N_0 = 2.23 \times 10^{22}$ cm^{-3}; for Ag^+, Br^-, and K^+ ions, in accordance with [1], S is equal respectively to 2.48, 4.85 and 8.75×10^{-14} cm^2.

[1] M. I. Kornfel'd and V. V. Lemanov, JETP **41**, 1454 (1961), Soviet Phys. JETP **14**, 1038 (1962).

[2] Devyatkova, Petrov, Smirnov, and Moĭzhes, FTT **2**, 738 (1960), Soviet Phys. Solid State **2**, 681 (1960).

[3] L. Genzel, Z. Physik **135**, 177 (1953).

Translated by E. Lepa
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REMARKS ON THE PAPER BY DEMIVOV, SKACHKOV, AND FANCHENKO ENTITLED CHANNEL EXPANSION IN INTENSE SMALL SPARKS

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1. Using a high-sensitivity electron-optical converter Demidov, Skachkov, and Fanchenko [1] were able to photograph the space-time development of a spark channel excited by discharging low-capacity condensers; on the basis of these photographs these authors conclude that the rate of expansion of the channel is 60—80 km/sec at the initial stage of the discharge.

It is our contention that these photographs are subject to a somewhat different interpretation than that given by the above authors. First, it should be noted that the extremely high rate of expansion of the channel is determined in a time interval of 0.25—0.5 nsec, in the course of which the channel radius is no greater than 15—30 μ. There is reason to believe that in this time period one is not observing the stage corresponding to hydrodynamic expansion of the channel, but rather the preceding stage, i.e., the streamer discharge. For example, according to the data of Saxe and Chippendale, [2] who obtained frame photographs of the development of a streamer with an electron-optical converter, propagation of the streamer in a discharge gap 1 cm in length continues for approximately 4 nsec, in which time the diameter of the luminous streamer remains smaller than 100 μ.

It is reasonable to assume that in the discharge studied in [1] the streamer diameter is finite as it moves from one electrode to the other and that the "channel expansion" observed in the photographs in Figs. 3—4 of [1] may actually characterize the geometric shape of the head of the streamer and its expansion.

To resolve definitely the question of the rate of expansion of a channel in a spark discharge in its initial stages of development it will be necessary to carry out additional investigations similar to those in [2], in order to determine the radius of the initial channel at the instant it bridges the interelectrode gap.

2. Demidov, Skachkov, and Fanchenko give data for the curvature of the current growth at the initial time, which is calculated on the basis of the known capacitance, the period of natural oscillations, and the gap voltage; the ohmic resistance, however, was neglected.

Investigations carried out by us have shown that for a hard spark discharge in air with energies of 0.01—1.0 joules at capacity values ranging from 500 to 5500 pF the maximum value of the curvature of the current growth is actually determined to a considerable degree by the resistance of the arc channel. In this case the maximum value of the curvature of the current growth is not reached when the current appears, but starts several nonoseconds later, when the current is approximately 500 A. [3,4] At small capacitance values the curvature of the current growth is still appreciably smaller than the quantity U/L (U is the gap voltage and L is the inductance of the discharge circuit).

On the basis of these data it may be assumed that the values of the curvature of the current growth given in [1] are too high.

[1] Demidov, Skachkov, and Fanchenko, JETP **40**, 385 (1961), Soviet Phys. JETP **13**, 263 (1961).

[2] R. F. Saxe and R. A. Chippendale, Brit. J. Appl. Phys. **6**, 336 (1955).

[3] S. I. Andreev and M. P. Vanyukov, Report to the Second Conference on High Speed Photography and Cinemaphotography, Moscow, May, 1960.

[4] S. I. Andreev and M. P. Vanyukov, ZhTF **31**, 961 (1961), Soviet Phys.-Tech. Phys. **6**, 700 (1962); Andreev, Vanyukov, and Komolov, ZhTF **32**, 57 (1962), Soviet Phys.-Tech. Phys. **7**, in press.

Translated by H. Lashinsky
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