CHANGE OF SPACING OF POSITIVE COLUMN STRIATIONS WITH TEMPERATURE

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Abstract

Cassen's prediction (Phil Mag. **268,** 948, Nov. 1926) that the separation of the striations in a discharge tube should increase almost linearly with the absolute temperature is verified for the wide blue striations. For the narrow striations, the separation first decreases, but in general reaches a minimum, after which the separation increases as predicted.

FROM theoretical considerations, Cassen[1] predicts that the distance between striations in the positive column of a discharge tube should increase almost linearly with the absolute temperature, and that the addition of an impurity may greatly change the spacing.

A vertical discharge tube was heated in a liquid bath contained in a large vertical glass tube. An electric heating coil was placed in the bottom of the bath and the temperature controlled by an external resistance. Two thermometers were placed in the bath at different heights to obtain the temperature. A large flask was connected to the discharge tube to minimize the change in pressure due to change in temperature of the tube. To secure steady striations which could be measured with a cathetometer, a potential of 3000 volts from small storage cells was used. The current was controlled by a water resistance and measured with a milliammeter.

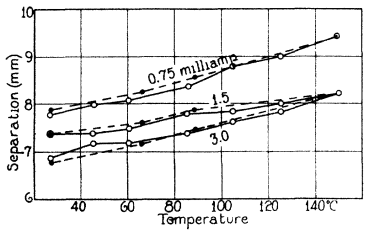

Fig. 1. Wide striations at a pressure of 1 mm Hg.

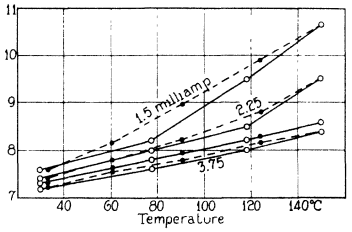

Fig. 2. Wide striations at a pressure of 1 mm Hg.

Hydrogen was used in the discharge tube because it gives striations over a much greater range of conditions than the other ordinary gases. Only the blue striations were obtained, these being due to impure hydrogen.[2] The pressures used were such that both the wide and the narrow blue striations appeared.[3] To detect any temperature lag or change in character of the gas, the separations were noted with both increasing and decreasing temperature.

The separation was gotten by measuring across several striations and

[1] B. M. Cassen, Phil Mag. **268,** 948 (1926).
[2] Handbuch der Physik, vol. 14, p. 298.
[3] Handbuch der Physik, vol. 14, p. 300.

dividing this distance by the number of striations measured. The separation in millimeters was plotted against the temperature of the bath in degrees Centigrade. Measurements were made for different values of the current because the separation varies with current.[4]

Figure 1 shows three curves, obtained at the same time, for current values of 0.75, 1.5, and 3 milliamp. Measurements were begun at room temperature, the unbroken line indicating readings with increasing temperature, and the broken line being for decreasing temperature.. Figure 2 shows another set of curves, for currents of 1.5, 2.25, 3, and 3.75 milliamp. Both these sets of curves are for the wide striations, at pressures of about 1 mm Hg. Figures 3 and 4 represent data for the narrow striations, at pressures of 2.5 and 1.7 mm.

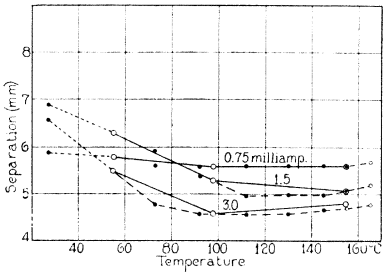

Fig. 3. Narrow striations at a pressure of 2.5 mm Hg.

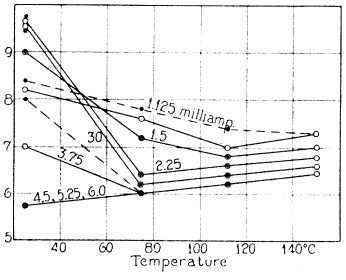

Fig. 4. Narrow striations at a pressure of 1.7 mm Hg.

In Fig. 3 the readings were begun at 155°C, the temperature lowered to 55°, then increased to 165°, and the last readings at room temperature were made the next day. In Fig. 4 no reading was made for a current of 6 milliamp. at 150° because the cathode became too hot. Figures 1 and 3 were made with prepared hydrogen, using one discharge tube, and Figs. 2 and 4 with commercial hydrogen, using a different tube.

Figures 1 and 2, representing the wide striations, agree with Cassen's prediction that the separation should increase almost linearly with the temperature. Figures 3 and 4, representing the narrow striations, show that the separations may first decrease but that they reach a minimum value and then increase linearly with the temperature. The curves for current values of 4.5, 5.25 and 6 milliamp. in Fig. 4 show only an increase in separation, which is in exact accord with the prediction. However, the minimum value of the separation seems to be shifted toward lower temperatures as the current is increased so that these curves might be expected to be similar to the others in the same figure, but with a minimum at some temperature below room temperature. Figure 3 also shows the shifting of the minimum to the left with increasing current. The deviation from Cassen's predictions might be explained by saying that his simplifying assumptions are valid only under certain conditions.

A series of curves was also plotted for hydrogen at 2.5 mm, after successive additions of impurity. The general shape of the curves was similar to those of Fig. 3, but they were shifted down to smaller values of separation, reaching a minimum, and then were shifted up to greater values.

[4] Handbuch der Physik, vol. 14, p. 301.