Electrical States of Iodine Vapour when emitting Line and Band Spectra

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When a Geissler tube containing iodine vapour is excited by an induction coil, the light emitted from the capillary part is chiefly of the line spectrum, while band spectra appear in a wide part of the tube. The object of the present experiment is to examine under what electric conditions of iodine vapour the line and band spectra will be emitted.

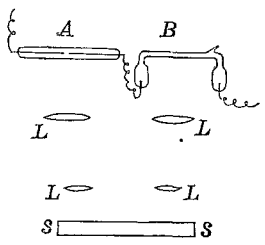
A single discharge due to a break of the primary of an induction coil consists really of a few partial ones. Now, when an iodine tube was excited by the coil, the colour of the glow corresponding to each partial discharge was found the same when examined with a rotating mirror. But when the tube was excited by a transformer, a single discharge in one direction consisted of many partial ones having different colours characteristic of the line and band spectra. The current strength in this case corresponding to these partial discharges was compared by means of an oscilloscope and a falling-plate camera.

When an oscilloscope was put in a circuit containing an iodine tube, the glow along the wire electrodes in the oscilloscope became too faint to give a good impression of the partial discharges on the falling photographic plate. Therefore a pair of plate electrodes having 1 cm. width were used instead of the ordinary wire electrodes and the glow was observed edgewise to increase the brightness. Such a tube was put in series with an iodine tube in a circuit containing a self-

induction and an adjustable capacity, and excited by a transformer giving about 5000 volts.

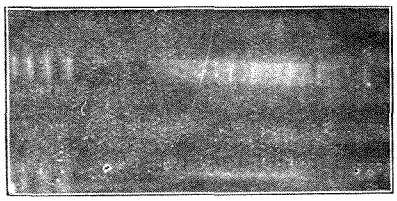
The arrangement of the tubes and optical system are shown in Fig. 1. *A* represents the oscilloscope, *B* an iodine tube and SS the slit of a falling plate camera, on which the images of both glows were formed lying side by side by means of a system of lenses L. As iodine tube, a fine capillary was dispensed with, and a piece of tubing of about 4 mm. internal diameter was used; and the condenser was so adjusted that the partial discharges through the iodine tube would emit the line and band spectra. Observations were preliminarily done with a rotating mirror on the colours of the glow of partial discharges in the iodine tube and the corresponding lengths of the glow in the oscilloscope.

FIG. I.



Now, in the case of discharges giving light in the line spectrum, the glow in the iodine tube was concentrated into the form of bluish green threads, but when the light was emitted in the band spectrum the whole section of the tube was filled up with a glow of a chamois yellow colour. Thus line discharges appeared as strong sharp lines on the photographic plates, while band discharges as rather faint broad bands. Owing to this difference it was easy to compare instantaneous currents corresponding to the glows emitting the line and band spectra. One of the photographs thus taken is shown in Fig. 2 and it was observed that the current in a partial glow giving the line spectrum is about three times that of the band discharge.

FIG. 2.



Next, it is desirable to know the potential gradients along the discharges corresponding to such partial ones, but we had no simple means of determining them. But when the iodine tube was excited by an induction coil, a discharge consisted of a few partial ones having all the same colour, the line spectrum appearing in a condensed discharge, while the band in a weak one. Thus, when a pair of fine platinum wires were inserted in the discharge tube and mean deflections of an electrometer, the terminals of which were connected to

platinum wires, were determined, corresponding to both weak and heavy discharges, they might be taken as a rough measure of potential gradients in the glows in the line and band discharges. The values thus found were 32 v/cm, 46 v/cm and 64 v/cm in the cases of the discharges emitting the light in the spectra as shown in Figs. 2, 3, and 4 in the preceding paper.

If we consider these results together with the results obtained by the oscilloscope experiments, it is seen that in the case of iodine the energy required to emit spark lines is about five or six times that of the band spectrum.

Summary

1. By employing a glow oscilloscope instantaneous current strengths in partial discharges emitting the line and band spectra of iodine were compared.

2. Potential gradients in the path of discharges emitting the line and band spectra were roughly determined.

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