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POSITIVE GLOW CORONA ALONG A CYLINDRICAL ROD BETWEEN TWO PARALLEL PLATES

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We have studied in room air the positive corona glow (Hermstein's glow [1]) along a stainless steel rod, 2 mm in diameter, equidistant from two parallel brass plates. The distance of the plates was 9 cm.

I/V CHARACTERISTICS.

As the rod was sustained by two rounded metal pieces, insulated from the plates and 20 cm apart, the discharge length increased with the D.C. applied voltage, because of the screening effect of these pieces. The corona current per unit length of the discharge obeys the well-known formula :

$$i = a V (V - V_g)$$

where a is a constant and V_g the threshold voltage. The length of the discharge was measured from photographs.

CURRENT RIPPLE

Ripples of the current and of the light flux from the discharge have been reported by many authors [2], [3], [4]. Their frequency is only a mean value since the period of oscillations is not really constant but fluctuates from one to another. In the investigated range (from 25 to 500 μ A) this frequency increases with the current from 115 kHz for 25 μ A and it tends towards a limit of about 440 kHz for 400-500 μ A. Previous observations with point-

to-plane gaps [4] had shown that, after a plateau, the frequency increased again.

The amplitude of oscillations varies at random. For relatively short time intervals the pattern looks like beats but for longer time intervals no regularity at all is observed. The maximum peak-to-peak variation represents 15 to 20 per cent of the mean current. This percentage tends to decrease when the current increases.

OSCILLATIONS OF THE LIGHT FLUX FROM THE DISCHARGE.

With a point-to-plane gap, the light flux from the discharge exhibits oscillations synchronized with the current ripple [4].

Two regions of the rod were imaged on slits and the intensity of the beams transmitted by the slits was studied with two photomultiplier tubes. The experimental arrangement is shown in fig. 1. The P.M.T. were in a fixed position. The optical arrangements stood on two carriages that could move along a rail for observation of various regions of the rod. An additional lens located between the mirrors and the P.M.T. reduced the beam divergence. The whole system was enclosed in a dark box in which fresh air was blown with a fan. Used air was evacuated out of the laboratory. Owing to the dimensions of the two carriages, the minimal distance between the

investigated regions of the discharge was 5 cm.

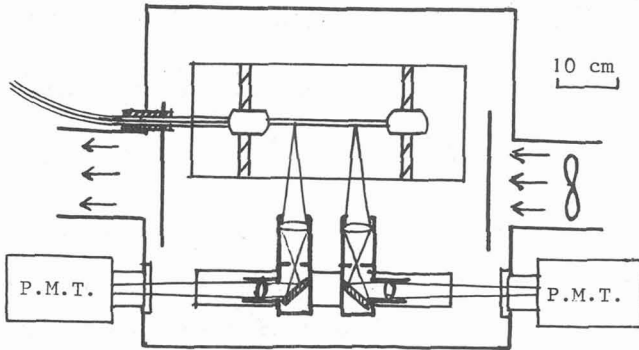


Fig. 1.— Arrangement for optical studies.

The P.M.T. currents were simultaneously observed with a 5444 dual beam Tektronix oscilloscope. A typical oscillogram is shown on fig. 2. No reproducible phase relation could be detected and a phase drift between the two traces of the same oscillogram was often observed.

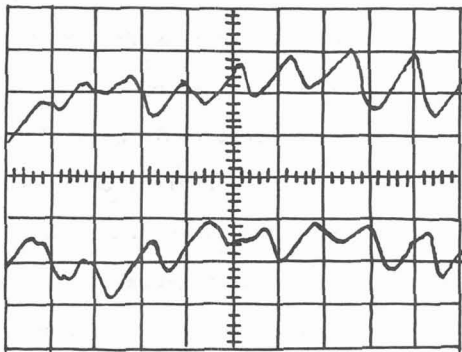


Fig. 2.— Oscillogram of the light flux from two different regions of the discharge
(2 μ s per division, $i = 400\mu$ A, $V = 40,4$ kV)

Similar observations occurred when a 32 mm metal sphere located at mid-rod divided the discharge in two parts.

Thus there is no coherence between the pulsations of the discharge along the rod when the distance exceeds a few cm.

Particularly, it is obvious from these data that the frequency of the phenomenon is not regulated by the external circuit, by a quenching effect of the protective resistor for instance, and this may be easily understood : the order of magnitude of the electric charge involved during one periode is 1 nC. Owing to the capacity of the electrodes and of the H.V. cable, the voltage drop should stand below 100 V, as compared to the applied voltage (27 to 43 kV), even if Q is suddenly liberated.

Finally, our observations disagree with Beattie's and Cross's, who found that the light-flux oscillations were coherent on the surface of a relatively large sphere in a mixture of N_2 and 1 per cent of O_2 [3]. However, experimental conditions were substantially different.

REFERENCES.

- [1] W. Hermstein — Arch. für Elektr. 45, 1960, p. 209-224.
- [2] R. Fieux, M. Boutteau — E.D.F. Bull. de la Direction des Etudes et Recherches. Sér. B, 1970, N°2, p.55-88.
- [3] J.E. Beattie, J.D. Cross — 3rd Int. Conf. on Gas Discharges, London 1974 — I.E.E. Conf. Publ. N° 118, p. 279-283.
- [4] R. Le Ny, Mrs A.M. Le Ny and A. Boulloud — 4th Int. Conf. on Gas Discharges, Swansea 1976. I.E.E. Conf. Publ. N° 143, p. 246-249.