60. *Cinematographic Sketch of Electrically Exploded Wires.*

By Hantaro NAGAOKA and Tetsugoro FUTAGAMI.

Institute of Physical and Chemical Research.

(Rec. May 8, 1928. Comm. by H. NAGAOKA, M.I.A., May 12, 1928.)

In our former communication,¹⁾ general aspects of the explosion of wires and moist threads were described simply by taking the photographs of the explosion either *in situ* or by means of rapidly rotating films. The former did not give the transition stages of explosion and the latter was simply limited to the continuous aspect of the phenomenon. The appearance of wires at successive stages of explosion was still desirable. This can evidently be secured by taking cinematographs with very rapidly moving shutters.

Instead of photographing the exploding wires on films rotating in a plane at right angles to the line of sight, it was advisable to receive the images on a film moving about an axis parallel to the wire. Mr. Ayabe constructed for us a stout drum of cast aluminium (diam. 20 cm), rotating on ball bearings about a steel axle with the speed which can be raised to 160 ~ per second by means of an electric motor. The peripheral speed was about 100 m per sec. In front of this were placed shutters made of thin aluminium plate; this was provided with 360 rectangular openings at equal intervals in radial directions near the periphery. The plate was attached to an electric motor, revolving 100 times per second, and encased in a hollow aluminium drum with two narrow slits parallel to each other. Only when the opening of the shutter and the slits coincided can light from the exploding wire reach the film, so that the appearance of the wire at intervals of $1/72000$ sec. was secured. Rapid as was the action of the shutter, it was still too slow to follow the oscillations of the electric current causing the explosion, the number of cycles being about 10^5 per sec. with small inductance. Photograms were taken by introducing enough inductance, so that the interval between successive shutters was shorter than the period of electric oscillations.

The figures represent cinematograms of Cu (0.08 mm thick, 5 cm long), Fe (0.25 mm thick, 30 cm long) wires and Mg (0.10 × 0.3 mm) ribbon. The outstanding feature of electric explosion consists in the

1) Nagaoka a. Futagami: Proc. Imp. Acad. **2** (1926) 328, 387.

expulsion of luminous particles *transverse* to the flow of the electric current; they do not come out continuously, but apparently form agglomerations. The light is most intense in the initial stage of explosion; when this is over, the bright patches start from both ends and gradually approach towards the middle, and after this the light fades away over the whole length of the wire or ribbon. Owing probably to the extremely high temperature to which the wire is momentarily raised, it seems to be much deformed in the middle portion, but it must be borne in mind that after the initial stage, the wire is evaporated and is in gaseous condition. As the variation of pressure in the surrounding air must be very great when the explosion is started, the deformation must be due to the effect of extremely hot vapour rising from the middle of the wire. The tapered appearance of the bright portion seems to be due to the same cause, following the accumulation of luminous centres by the rapid current of air. A glance at successive stages of explosion of Mg ribbon shows that it was broken at one end on entering the state of emitting light; at the second and the third stage, the ribbon entered the exploding condition all over its length. Evidently there was cooling near the broken end, so that the light faded away while the other portion was still bright.

The iron wire was three times thicker than Cu, and six times longer. The first state was similar to others, but in the second and the powerful condition of explosion, it was crumpled and emitted intense light. In the third stage, the light was much enfeebled that it became misty, leaving only the tails of former explosions. Obviously the wire was all vaporised on reaching this state.

These are but sketches; a more complete description will be given in the Scientific Papers of the Institute.

Fe