7-9 On the New Low Conductance Switching and the Applications

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A rapid transition from a higher conductance to a lower one - switching to low conductance - is observed in liquid selenium (F. Mahdjuri, J. Non-Cryst. Solids 8-10 (1972) 922). Applying a voltage pulse higher than the switching voltage causes a current drop after a time delay (Fig. 1). The delay time depends on the pulse voltage. Increasing the applied electric field decreases the delay time. The switching to low conductance is also observed in some liquid Se-Te mixtures. An increase of the tellurium concentration causes a greater switching current density.

Because of the larger electrode distance (some mm) we could construct a measuring cell with an observation window between the electrodes. After switching to low conductance a high electric field splits the liquid between the electrodes into two parts. The gap is perpendicular to the electric field. On the interface of the gap and liquid a weak luminescence is observed. The two liquid surfaces bounce together if the applied voltage is switched off. The split of the liquid seems to be caused by the electric field because of the negative I-V-characteristic after switching.

I shall also report on the observation of an intensive light emission in some liquid Se-Te mixtures caused by the electric field.

The switching to low conductance can be used, for example, to construct a disconnecting devices without sparks on breaking. This shut-down procedure could be used for high voltage as well as for power plants. The circuit diagram is shown in figure 2. SD is the liquid switching diode. S1 and S2 are the mechanical switches. If the switch S1 is opend the current flows via SD and the switch number 2. After the delay time (depends on the ohmic drop of the voltage at SD) the durrent will be reduced by SD up to 1/1000 times. S2 switches off the reduced current. This shut-down procedure can be used by ohmic as well as inductive power plants.(We could switch off a labor magnet - 60 000 Ampere X winding - without observing any spark.) The switching current density of liquid selenium is about 100 A/cm^2 (Se-Te mixture more than 1000 A/cm^2). The switching voltage reaches 1000 V/cm.

The splitting of the liquid after switching can be used as an optical chopper.

Fig. 1: Current time characteristic of liquid selenium at 965 °C applying a rectangular pulse of 50 V (20 msec/div)

Fig. 2: Circuit diagram of shut-down procedure

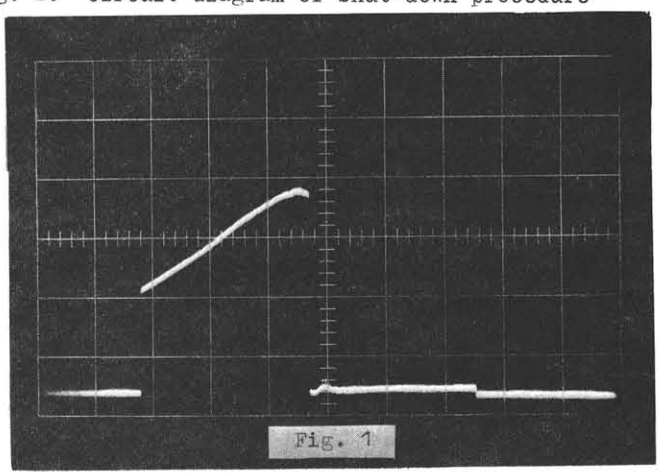

Fig. 1

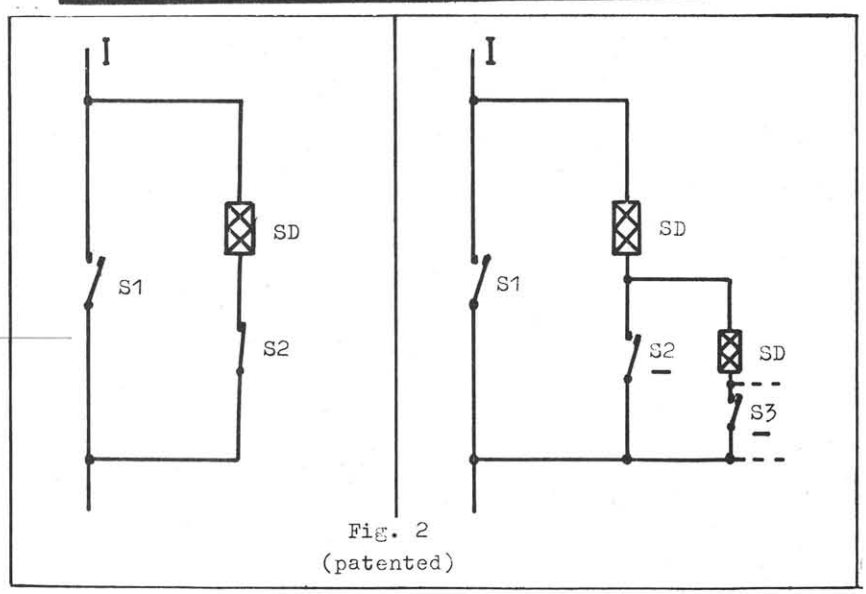

Fig. 2
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