CORONA STREAMER COUNTER AS A FAST PULSE GENERATOR

By

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Abstract :

The corona streamer counter has been used as a fast pulse generator for testing fast coincidence circuits and its characteristics investigated in detail. The rise time of the pulses from the streamer counter are estimated to be $\leq$ 5 nanoseconds.

1. INTRODUCTION :

Fast pulse generators with pulse frequency in nanosecond range are very necessary for testing fast electronic circuits. Gupta and Saha (1) used a spark counter as a simple type of fast pulse generator (of rise time $\angle$ 4 ns), for testing fast coincidence circuits. In practice, such type of pulse generator suffers from limitations of long dead time ($\sim$ 100 μ sec.) and damage of electrodes by sparking which changes its characteristics with prolonged operation. But if sparking operation is replaced by corona — streamer mode (2) the previous mentioned defects can be avoided and the counter becomes self-quenching with dead time $\sim$ 200 nsec (3). It is thus worthwhile to investigate the corona streamer pulse generator characteristics.

2. EXPERIMENTAL ARRANGEMENT.

Fig. (1) shows the experimental arrangement which is relatively simple. The counter consists essentially of a tungestun wire (0.12 mm $\varnothing$) as anode stretched taut and parallel to a polished stainless steel plate as

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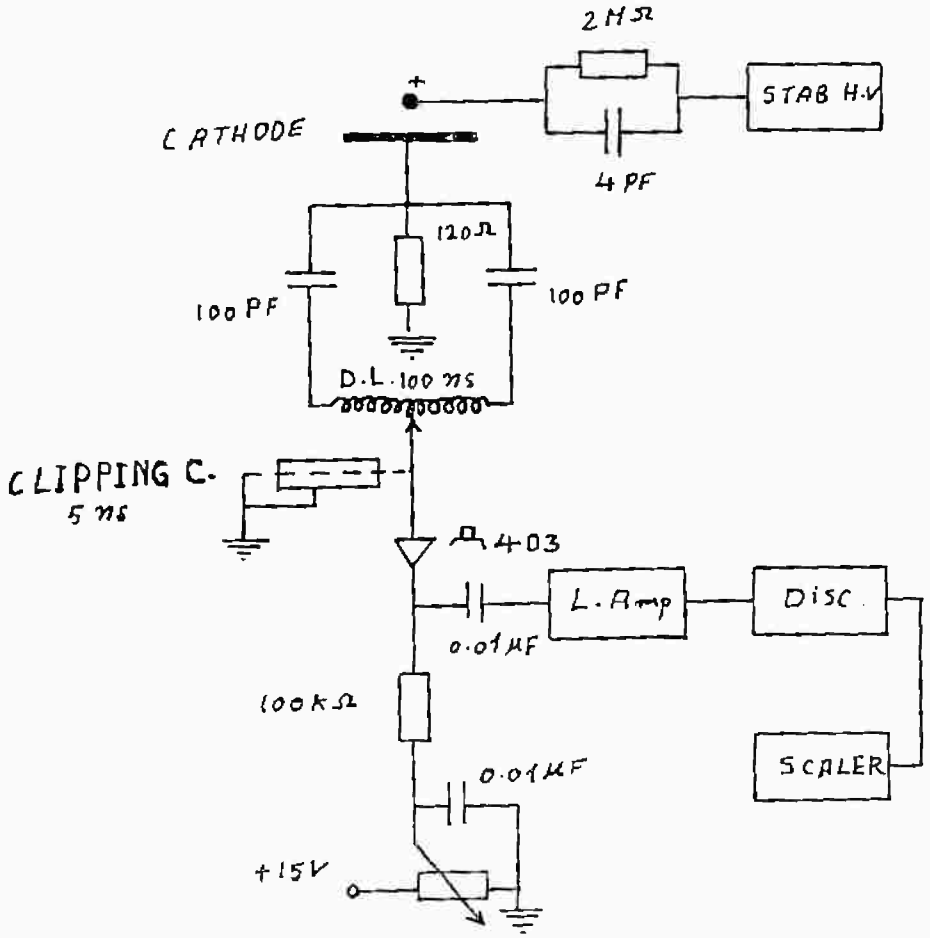

Fig. 1 — Coincidence arrangement.

cathode (7 × 4 cm² area). The wire-plate seperation is 5 mm. A Po^{210} α — Source was used for producing streamer pulses. Alpha radiation is limited by passing through Cu collimator containing 25 cylinderical holes (each 1 mm ø and 3 length). The number of pulses can be varied by either changing the distance of the source from the counter or closing part of the collimator holes by a special shutter. The amplitude of the out put pulses from the cathode can be varied from 3 to 18.5 volt by varying the voltage Va through out the corona streamer rang for a cathode load resistance of 100 Ω . Fig. 2 shaws the results. When the 100 Ω resistance is replaced by 1 k Ω variable resistance and keeping Va equal to 5 K V the pulse amplitude can be varied from O to ~ 8 V by varying the resistance. With the later case the rise in the pulse amplitude is accompanied by an increase in the pulse rise time.

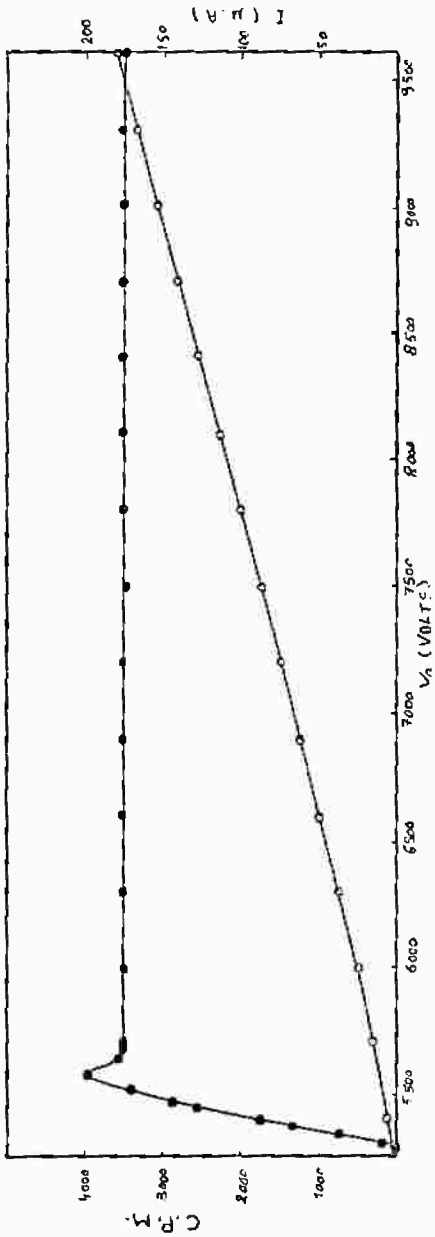

Fig. 2 — Pulse amplitude us applied voltage V_B

The streamer counting characteristics were determined with a cathode load resistance equal to 1 K Ω and is shown in Fig. 3. Also within the streamer rang of operation the change in corona current with applied voltage Va is shown in the same Figure. The out put pulse with 100 Ω cathode load resistance observed over a Tektronix 531 A oscilloscope with sweep speed 5 div. = 20 ns showed a rise time of 20 ns. This apparent pulse rise time was limited by the rise time of the vertical amplifier of the oscilloscope. In fact pulses from such a corona streamer counter have much better rise time as the prompt coincidence analysis shows fig. 4.

3. *COINCIDENCE STUDY OF PULSE RISE TIME :*

The circuit used is as shown in fig. 1. The out put pulses from the cathode enter both ends of the coaxial delay line (helicoid). The short circuit clipping cable (5 ns) is connected to the sliding contact carriage of the coaxial line which can move along the coaxial line length. Thus a variable delay is inserted into the channels due to the line length change. The sliding carriage had been constructed to indicate delay up to 0.1 ns. The Π 403 diode discriminator, linear amplifier and amplitude discriminator were used to discriminate singles from the coincidence. Fig. 4 shows the prompt coincidence resolution curve obtained by introducing negative and positive time delays by moving sliding contact carriage from the center of the coaxial cable along its sides. The resolving time is 5 nanosecond. It is therefore concluded that the rise time of the counter pulses is equal if not better than 5 nonosecond. Probably a better resolving time can be obtained by using smaller clipping times. This was not done as the amplitude of the pulse becomes very small.

4. *DISCUSSION :*

It is to be noted that the 2 M Ω anode load resistance connected with the corona streamer detector is not intended to function as an external quenching resistor since the discharge is antoquenched (3). It is inserted in the circuit in order to decrease the rate of change of electrode potential with the applied high voltage Va (corona stabilizer actiou). The shunted 4 PF capacetor to the 2 M Ω resistance is used so as to get a faster recovery of the anode. Also by using oscilloscope tests the background corona current noise level was found to be negligible relative to the streamer pulse hight.

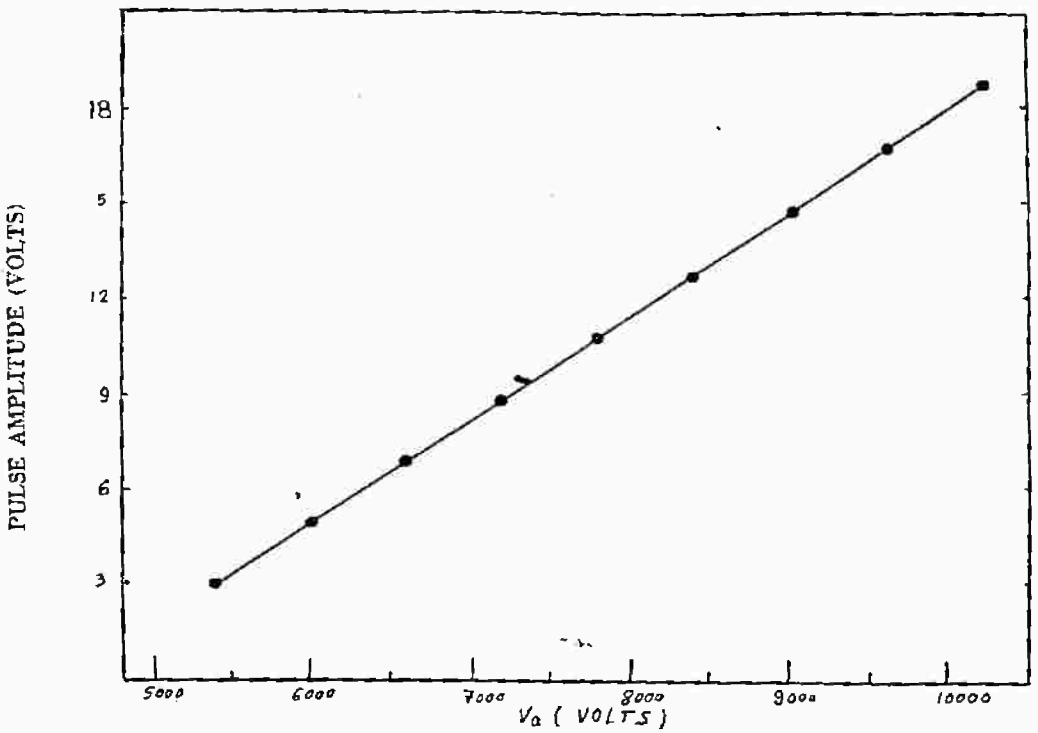

Fig. 3 — Corona streamer counter counting and corona current characteristics.

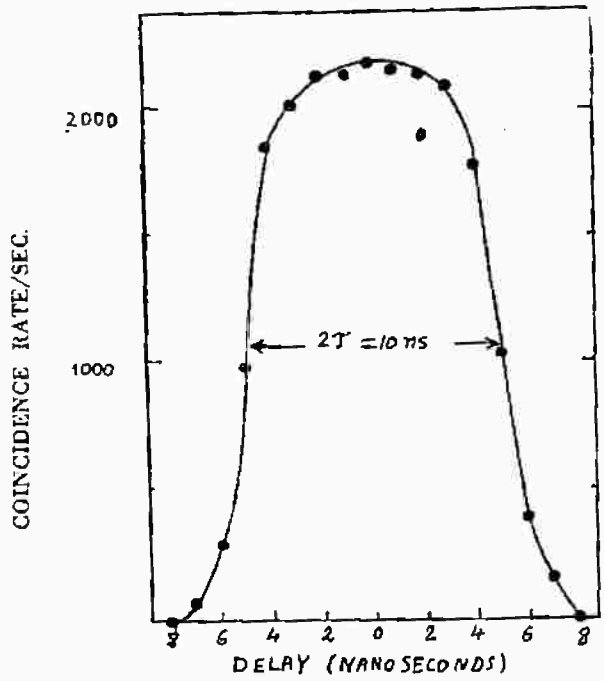

Fig. 4 — Po^{210} prompt coincidence resolution curve.

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