Letters to the Editor

The Board of Editors does not hold itself responsible for opinions expressed in the letters published in this section. The notes containing short reports of original investigations communicated to this section should not contain many figures and should not exceed 500 words in length. The contributions reaching the Secretary by the 15th of any month may be expected to appear in the issue for the next month. No proof will be sent to the author.

1

IMAGE INVERSION OF GEIGER PULSE

R. C. SASTRI AND S. D. CHATTERJEE

JADAVPUR UNIVERSITY, CALCUTTA, 32, INDIA.

(*Received January* 25, 1967)

In a normal Geiger counter operation, it is customary to maintain the axial wire at a positive potential, as suggested in the original paper of Geiger and Müller (1928) Such an arrangement yields a negative pulse at the wire due to the collection of electrons. The mechanism of pulse formation due to the motion of ions in an ion-chamber or a counter and its effect on external circuits has been discussed in some details by Curran and Craggs (1949). Curran and Reid (1948) have also described properties of some new types of counters, viz., (1) rectangular cathode with symmetrical and non-symmetrical wires and (2) circular cylindrical cathode with non-axial wire. In either case, such counters have shown improved dead time and reduced coincident cosmic-ray background.

Using the second type of counter, having both an axial and a non-axial wires situated within the same circular cylindrical cathode, an interesting new feature has been observed. The circuit arrangement is depicted in Fig. 1.

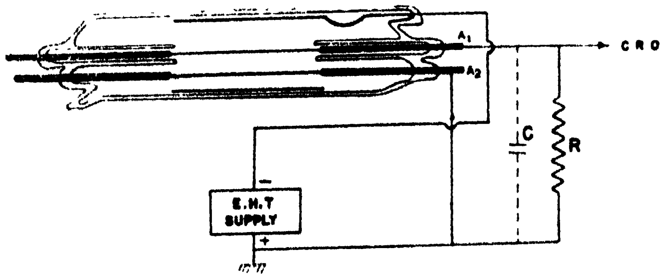

Fig. 1. Circuit arrangement for the study of image inverted pulses in a Geiger counter.

Case A : Negative potential is applied to the cylinder. The axial wire A_1 has a bigger diameter ($\sim$12 mil) than that of the offset wire A_2($\sim$4 mil). The former is connected to ground through a resistance R so that the pulse could be transferred to a Tektronix oscilloscope; C is the distributed capacity of the wire and anything attached electrically to it. The offset wire A_2 is normally grounded either directly or through an auxiliary battery.

The axial wire A_1 having a relatively large diameter, does not promote Townsend avalanche in its neighbourhood and is in a quiescent state with a moderate cathode voltage, when the offset wire is left floating. However, when the latter is grounded, positive pulses simulting Geiger pulses appear at the terminal of the axial wire. The rise time and dead time of these pulses are of the same order of magnitude as of Geiger pulses, although the amplitude is correspondingly less. The latter can be varied within limits by varying the voltage of an auxiliary battery connected to the offset wire A_2. Fig. 2 gives a photographic reproduction of such positive pulses.

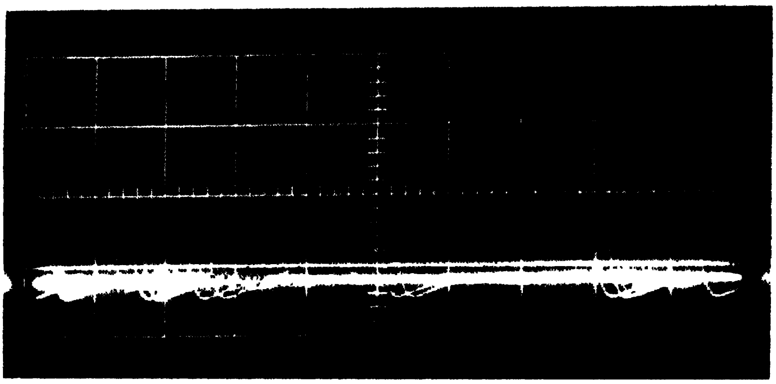

Fig. 2. Image inverted (positive) pulses at the terminal of the axial wire.

Case B: The operating condition of the counter is kept the same as before, excepting that the two wires are made identical in diameter (~ 4 mil.). Under such conditions, the counter appears to behave as two separate counters. However, the pulses appearing at the axial wire consist of both positive and negative pulses as shown in Fig. 3. The reflected positive pulses look sharper, because of smaller time-constant of the offset wire assembly.

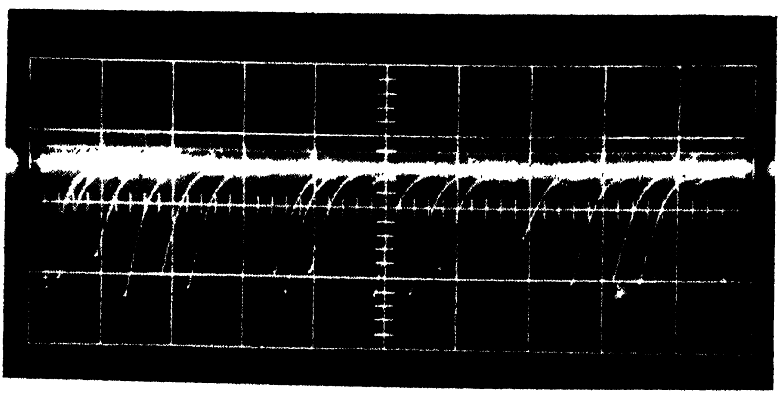

Fig. 3. Image inverted (positive) pulses, superimposed on normal Geiger (negative) pulses.

With slight modification of the circuit parameters, the behaviour of the axial and non-axial wires can be made mutually reversible. It may, however, be noted that the field-strength in the multiplicative region of the non-axial wire is about 15 per cent higher (Curran *et al.* 1948) than the field-strength at the corresponding region of the axial wire, resulting in a lower threshold potential of the former.

Looking at the results, it seems reasonable to suppose that case A represents the physical situation of a charged hollow cylinder enclosing two parallel cylindrical conductors of same finite lengths and having different diameters. The axial wire is grounded through a resistor, while the non-axial one is subjected to intermittent and transient charges. Accordingly, the positive pulses may possibly be identified with image inverted pulses, whose amplitude depends upon image attenuation factors (Harnwell, 1949).

REFERENCES

Geiger, H. and Muller, W. 1928, *Phys. zeit.* **29**, 839.
Curran, S. C. and Craggs, J. D. 1949, *Counting Tubes* Academic Press Inc. London, *36*.
Curran, S. C. and Reid, J. M. 1948. *Rev. Sci. Inst.* **19**, 67.
Harnwell, G. P. 1949, *Principles of Electricity and Electromagnetism* McGraw Hill Book Co. Inc., New York, 511.