MINIATURE GEIGER-MÜLLER COUNTER

By Leon F. Curtiss

ABSTRACT

A miniature Geiger-Müller tube counter having a tube 0.8 mm in internal diameter is described. This "hypodermic-needle" type of counter has been found useful in locating and measuring a well-defined beam of gamma radiation. It could also be used to measure a beam of hard X-rays reflected from a crystal. Another suggested use is direct insertion into specimens, such as living biological material.

There are many applications for which a Geiger-Müller counter of very small size would be useful. Where it is desirable to measure and locate a narrow beam of radiation, it would be very convenient to have a counter approximately the size of the cross section of the beam. This requires a counter of the order of 1 mm in diameter. The author knows of no previous attempts to construct counters of such size.

The ease with which thoroughly reliable counters containing alcohol vapor and argon may be constructed led to the trial of small counters. No difficulty was encountered in constructing counters with an internal diameter of 3 mm. Counters of this size give slightly larger pulses than is obtained from counters 2 or 3 cm in diameter. They also show a reasonable plateau and are quite stable. Counters of this diameter would not serve to locate a well-defined beam of radiation with sufficient precision for some purposes.

Encouraged by the results with the 3-mm counters, the author constructed the counter shown in figure 2. The No. 2 sewing needle is included in the picture for size comparison. The tube of the counter has an internal diameter of 0.8 mm and a length of about 3 mm. The central wire is tungsten, 0.05 mm in diameter. The filling gas is a mixture of amyl acetate vapor and argon at about 4-cm pressure.

This counter has an extremely low blank, averaging around 20 pulses per hour. The pulses are even larger than those from the 3-mm counters. This increase of pulse size with decrease of tube diameter could be expected from the known fact that the ionization is confined to a thin sheath near the central wire. The thickness of this sheath is increased as the tube becomes smaller, since the ratio of maximum to minimum gradient is smaller for the counter tube of smaller diameter.

The plateau for this counter is shown in figure 1. Although it is considerably steeper than for larger counters, this counter yields good results when operated from a stabilized voltage. This particular

counter has been in use for several months with no sign of deterioration.

The shape of the counter resembles a large hypodermic needle, which suggests another type of use. It could be introduced directly into material to be tested and therefore increase the sensitivity of the measurement. This could be of value in studying biological specimens. It could even be used with live animals. No attempts have been made to construct counters of smaller diameter, but it seems likely they could be made. The chief difficulty is in devising a method of locating the central wire so that it does not touch the counter tube. Exact centering of this wire is not necessary, since the only precaution taken with the present counter was to make certain that the wire was not in contact with the tube.
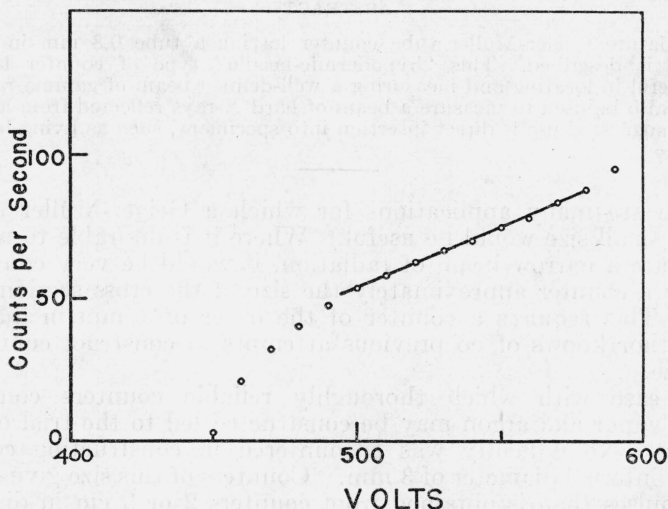

FIGURE 1.—*Hypodermic-needle-type Geiger-Müller counter.*

Further work is in progress in an effort to improve the characteristics of these miniature tube counters and to determine the lowest limit of tube diameter that can be used.

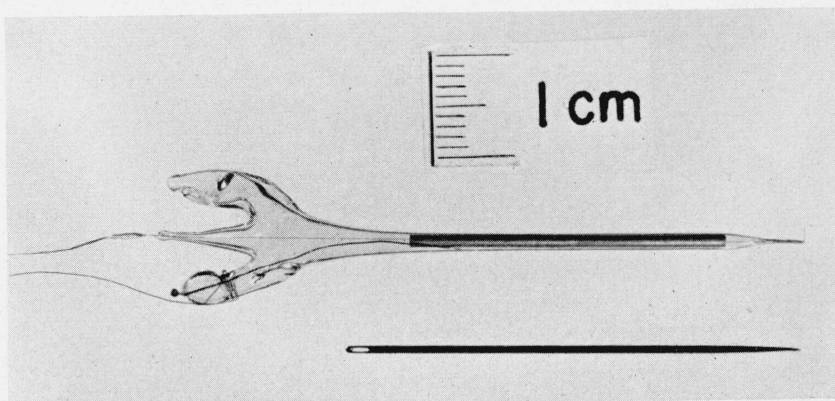WASHINGTON, December 2, 1942.

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FIGURE 2.—*Miniature Geiger-Müller counter.*
The sewing needle is included for size comparison.

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