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GEIGER-MULLER COUNTER FOR RADIOACTIVE EMISSION

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Fig. 1.

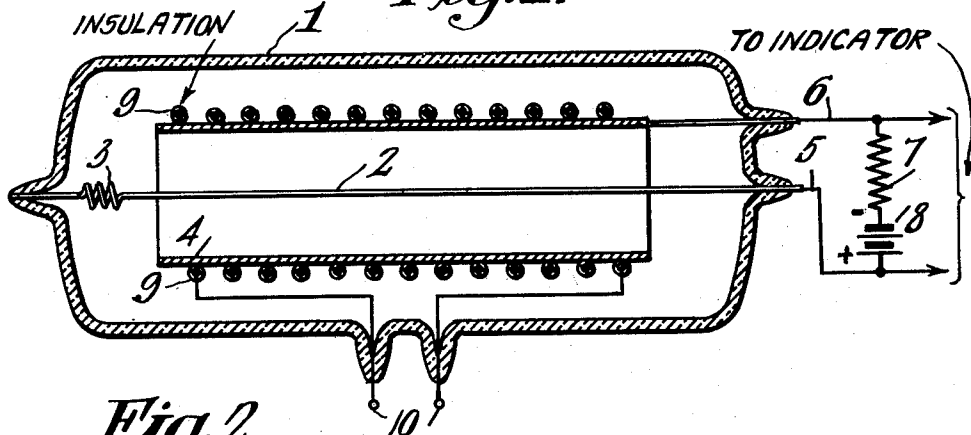


Fig. 2.

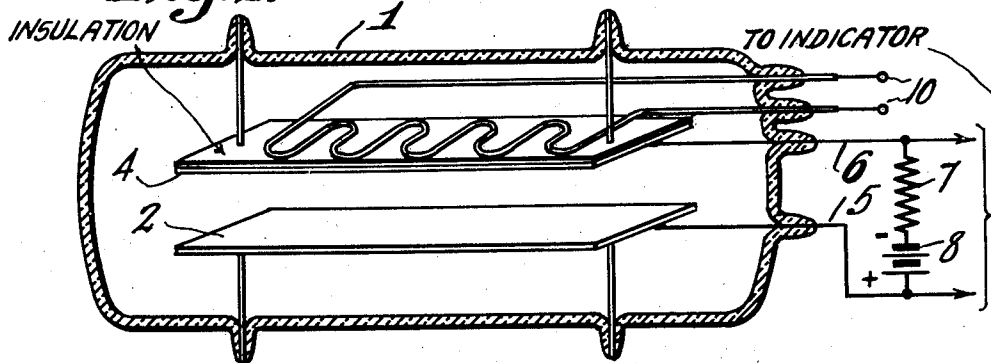
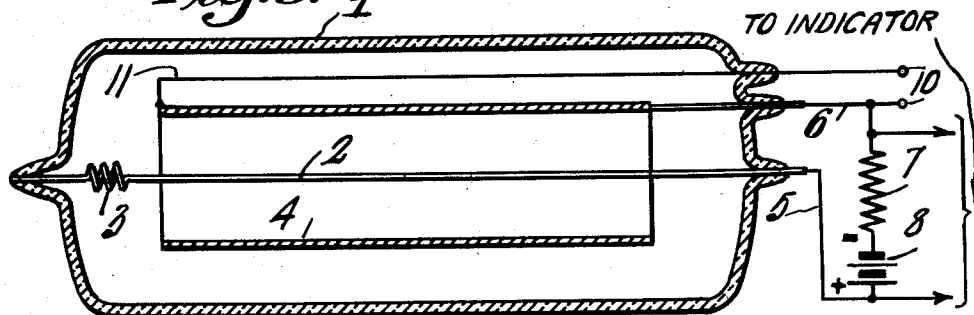


Fig. 3.



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GEIGER-MÜLLER COUNTER FOR RADIO-ACTIVE EMISSION

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7 Claims. (Cl. 250—27.5)

1

This invention relates to Geiger-Müller counters and particularly to such counters in which spurious counts are reduced to a negligible quantity.

Geiger-Müller counters vary as to structural forms and arrangements, but consist essentially of an envelope or tube permeable to nuclear radiations in which tubes are mounted an anode and a cathode, with suitable leads passing through the envelope for connections to the external circuits. The envelope is exhausted in the conventional manner and certain gases or mixtures of gases are then drawn into the tube to provide a medium within the envelope susceptible to ionization by collision by nuclear radiation and primary and secondary cosmic rays.

A source of high electric potential is connected between the anode and cathode and a high resistance, usually of the order of 10^9 ohms, is connected between the anode and cathode. The anode and cathode are also connected to a current indicating device.

In operation, the potential across the anode and cathode is adjusted to a value that in the absence of any nuclear radiation penetrating the medium of the tube, the potential is just insufficient to break down the resistance of the medium. However, when nuclear radiation penetrates the medium, ionization of the medium occurs and large conduction currents flow in the external circuit. The electrons are drawn to the positive electrode, anode, and the positive ions are drawn to the cathode. Upon the flow of current, the drop of potential along the high external resistance serves to restore the medium to its non-conducting state.

It has been observed, especially in the so-called parallel plane type of Geiger-Müller counter, that after a flow of current through the medium initiated by a nuclear radiation unit, the device registers other or "spurious" counts. These spurious counts cannot be distinguished from initial counts by the current indicating device and hence the counter does not indicate the true or accurate number of radiation units permeating the medium.

The spurious counts are believed to be due to electron emission from the cathode caused by the positive ions, produced by ionization, being deposited upon a thin insulating film or scattered particles of insulating material on the cathode. These ions set up a sufficiently strong field between themselves and the metal backing of the cathode to produce field emission of electrons from the metal through the insulating film.

2

These electrons pass into the medium and cause ionization as previously described, and the indicating means responds to the produced conduction currents.

Efforts have been made to eliminate the thin insulating film or particles on the cathode to avoid spurious counts, but without success. The exact nature of the film or particles is not known, but it is believed to be a form of oxides of the cathode material or it may be caused by or consist of impurities. The cathodes of these tubes have been cleaned in the past with meticulous care and spurious counts have been somewhat reduced, but the spurious counts have not been eliminated.

The principal object of the invention is to provide improved methods of and means for eliminating spurious counts in Geiger-Müller counters.

Another object of the invention is to eliminate spurious counts in Geiger-Müller counters by preventing electric field emission of electrons from the cathodes of Geiger-Müller tubes.

Another object of the invention is to eliminate the insulating effect of the thin film or insulating particles on the cathodes of Geiger-Müller counter tubes.

Other objects will be apparent from the disclosure of the invention as hereinafter set forth in detail and from the drawings made a part hereof in which Figure 1 is a diagrammatic sketch of a tube of the invention in which the cathode is heated by a coil of resistance wire; Figure 2 is a diagrammatic sketch of a tube of the invention in which the cathode is heated by a pancake resistance unit; and Figure 3 is a diagrammatic sketch of a tube of the invention, the cathode of which is heated by a current passing through the cathode.

Similar reference characters are applied to similar elements throughout the drawings.

Referring to Figure 1, numeral 1 represents the envelope or tube of a Geiger-Müller counter tube. The anode 2 is, in this embodiment, mounted in the longitudinal axis of the tube 1 and is held taut in position by spring 3 secured at the end of tube 1 in any conventional manner. The cathode 4, shown as a cylinder, is mounted coaxially the tube 1. Leads 5 and 6 are the terminal connections of anode 2 and cathode 4, respectively. Resistance 7 and a source of electric potential 8 are serially connected between leads 5 and 6. Surrounding cathode 4 is a resistance wire coil 9 connected to a second source of electric power 10.

Referring to Figure 2, the anode 2 and cathode

3

4 are in the form of plates secured in parallel position by any conventional means. The heating coil 9 is shown as a flat or pancake type in contact with cathode 4 and connected to the second electric source 10. Resistance 7 is serially connected with the first electric source 8 between terminal leads 5 and 6.

In Figure 3, the tube construction is similar to that shown in Figure 1, except that the cathode 4 is heated by passing electric current from the second source 10 through the cathode 4 by connecting terminal lead 6 to source 10, the other connection to the second source 10 being wire 11, which is connected to the far end of cathode 4.

In operation: upon the application of heat to cathode 4, it has been found that electrical resistivity of the scattered particles or of the thin insulating film on the cathode is reduced to such an extent that the film becomes conductive. The charges of the positive ions deposited on the film, therefore, leaks so rapidly to the cathode that the electric field between the positive ions and the cathode does not reach a magnitude sufficient to produce field emission of electrons from the cathode.

The currents through the heating coils is so adjusted that thermal electron emission from the heating coil or the cathode does not occur and yet so adjusted that the resistivity of the thin film on the cathode is reduced. The condition of maximum currents in the heating coils of this invention may be determined by observing the maximum current at which the counter tube indicates no ionization when the medium of the tube is not subjected to nuclear radiation. Likewise, the minimum current is observed as that at which no spurious counting occurs.

In each of the embodiments of the invention described heretofore, output energy from leads 5 and 6 may be applied to any conventional Geiger-Müller indicator device which may include as much amplification as desired.

I claim as my invention:

1. The method of eliminating spurious counts by a Geiger-Müller counter tube which tube includes an anode and a cathode, comprising: the applying of heat to said cathode in an amount sufficient to reduce the internal tube impedance substantially and in an amount less than results in substantial cathode thermal electron emission.

2. The method of eliminating spurious counts by a Geiger-Müller counter tube which tube in-

4

cludes an anode and a cathode on which cathode is a thin insulating film or scattered particles of insulating material, comprising: the applying of heat to said cathode in an amount sufficient to substantially reduce the resistivity of the said insulating film or particles whereby the said film or particles becomes conductive and in an amount less than results in substantial cathode thermal electron emission.

3. The method of eliminating spurious counts by a Geiger-Müller counter tube which tube includes an anode and a cathode, comprising: passing a current through said cathode, whereby the said cathode becomes heated, the value of said current being sufficient to reduce the tube internal impedance and less than an amount which results in substantial cathode thermal electron emission.

4. A Geiger-Müller counter tube comprising: an anode, a cathode, and means for heating said cathode in an amount sufficient to reduce the internal tube impedance substantially and in an amount less than results in substantial cathode thermal electron emission.

5. A Geiger-Müller counter tube comprising: an anode, a cathode, an electric resistance coil juxtaposed said cathode, and means for passing an electric current through said coil, the value of said current being sufficient to reduce the tube internal impedance and less than an amount which results in substantial cathode thermal electron emission.

6. A Geiger-Müller counter tube comprising: an anode, a cathode, and means for passing an electric current through said cathode electrode, whereby said cathode is heated, the value of said current being sufficient to reduce the tube internal impedance and less than an amount which results in substantial cathode thermal electron emission.

7. A Geiger-Müller counter tube comprising: an anode, a cathode, the said cathode having an insulating film or scattered particles of insulating material thereon, means for heating said cathode in an amount sufficient to substantially reduce the resistivity of said film or particles whereby the said film or particles become conductive and in an amount less than results in substantial cathode thermal electron emission.

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No references cited.