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RADIATION COUNTER

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FIG. 2.

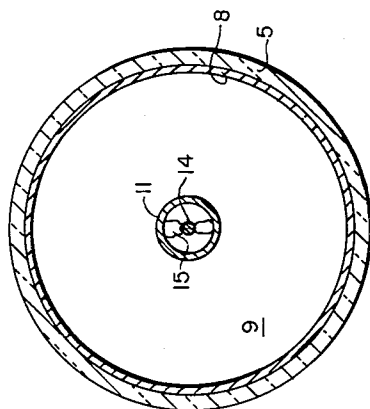
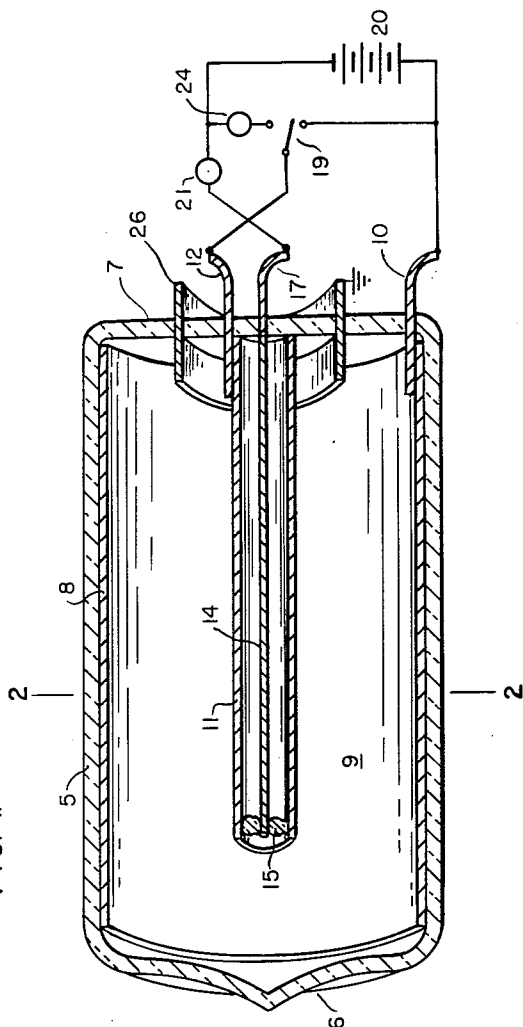


FIG. 1.



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RADIATION COUNTER

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4 Claims. (Cl. 250—83.6)

(Granted under Title 35, U. S. Code (1952), sec. 266)

The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment of any royalty thereon.

This invention relates to radiation counters, and more particularly to radiation counters of the ionization chamber, and Geiger-Müller counter types, and such devices for detecting and measuring penetrative radiation.

The ionization chamber type of radiation detector may consist of concentric electrodes and a confined gas between them, the gas being ionized by the incident radiations to result in a flow of current between the two electrodes when a voltage is applied across them. The Geiger-Müller counter type of radiation detector is similar physically but usually of smaller dimensions and greater sensitivity. The Geiger-Müller counter has a greater sensitivity because it takes advantage of a gas multiplication process wherein each ionizing event results in a complete break-down of the gas in the tube to cause a relatively large momentary current flow. The ionization chamber has a flow of current proportional to the degree of ionization, while the Geiger-Müller counter has a flow of current proportional to the number of ionizing events.

Both types of detectors are necessary since the current flow in the chamber would be virtually immeasurable while the Geiger-Müller counter is effective and the Geiger-Müller counter is completely saturated by radiation densities that cause an appreciable flow of current in the chamber. These tubes are commonly used as separate units in conjunction with one another to provide detection over a wide range of radiation.

It is, therefore, an object of this invention to provide an ionization chamber and a Geiger-Müller counter in a common envelope.

It is a further object of this invention to provide a simple and effective structure to perform the functions of both ionization chamber and Geiger-Müller counter.

It is a further object of this invention to provide a Geiger-Müller counter of considerably longer life than a standard counter of equivalent size.

These and further objects of this invention will become apparent from the following specification and the drawings, in which

Figs. 1 and 2 are sectional views of a preferred embodiment of this invention.

Fig. 1 shows a sectional view along the axis of the device, including electrical terminals. Appropriate electrical circuits are also shown.

Fig. 2 shows a sectional view perpendicular to the axis.

Referring now to the drawings in which like parts are similarly numbered, an outer, cylindrical shell 5 is closed at one end by a surface 7 sealing the contacts to the various electrodes and at the other end by a tip 6, providing conventional means for exhausting the enclosure. A metallic sleeve 8 is just inside the shell and connects through the end piece 7 to terminal 10. A second metallic sleeve or cylinder 11 is mounted on the end surface 7 to extend any desired length within the enclosure and is sub-

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stantially concentric thereto. A terminal lug 12 extends through the end piece to provide electrical contact.

A rod 14 extends through the center of tube 11 and is held in place by a dielectric mounting 15 and the end piece 7 through which it extends to terminal 17.

The enclosure 9 may be filled with any desired gas at any reasonable pressure. The gas chosen, and the pressure, will vary according to the characteristics of the tube.

In operation, the tube is used in two separate circuits whose functions will presumably overlap to provide a continuous coverage of the maximum possible radiation intensities. Since only one circuit need be used at any one time a single power supply 20 can be used in connection with the circuits of either 21 or 24, with switch 19 used to change from one circuit to the other. In the Geiger-Müller circuit, for measuring low radiation densities and electron voltages the circuit of indicator 21 may be used with power supply 20 connected in series with terminals 12 and 17 through switch 19. The outer electrode, as in conventional practice, may be the cathode.

The other circuit, more effective as an ionization chamber for higher radiation intensities, has voltage supply 20 connected through measuring system 24 in series with terminals 10 and 12. Here the outer electrode 11 of the inner detector becomes the inner electrode of the outer detector and may be used as the anode. Since this circuit is intended to operate over a wide range of radiation intensities, and, as noted before, the ranges need not overlap, it is obvious that one battery can be used and switched from one circuit to the other. However, the switching function can be avoided and the calibration simplified by using separate power supplies for each circuit. This would also allow both detectors to be used simultaneously.

When the radiation, primarily of gamma rays, penetrates the tube 11, a current flows between electrodes 11 and 14 which is detected by a scaling or integrating circuit, or a well damped ammeter. The density of radiation and the electron voltage of the incident photons, the sizes of the electrodes, the spacing, the materials out of which they are constructed and other physical characteristics determine the flow of current for a given condition. The physical characteristics of this device are preferably chosen for an air equivalence. That is, the ionization effect of the radiation within the enclosure should approximate the ionization effect of the same radiation on air. Thus, for example, the thickness and physical dimensions of the wall material, the gas used and its pressure are chosen to provide an ionization within the enclosure approximating that of air.

The radiation incident on the gas between electrodes 8 and 11 ionizes the gas proportionally to the radiation and with voltage 20 applied across the terminals 10 and 12 a current will flow through measuring circuit 24 to be detected and recorded thereby. However, the current flow here is considerably less than that of the inner tube, and, since the current can be varied by certain changes in the physical characteristics of the outer unit, these are chosen so that the current in the outer circuit becomes appreciable at approximately the time the current in the inner unit reaches saturation. Thus, the outer circuit readings cooperate with the inner to provide a continuous indication of radiation.

The switch 19 may be actuated by suitable relays controlled by the current in one or both of the circuits, thereby making the device automatic. It is also possible to choose the values of the circuits to have one ammeter—properly calibrated in two ranges—serve as an indicator for both circuits.

The walls of the chamber may be of any type of material from metals to conductive plastics. The sleeve 8 may be a coating or plating of suitable conductive material inside the outer cylindrical shell 5, or the outer shell may

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be made of suitable conductive material and so that the inner sleeve 8 is unnecessary. The thickness of the material will vary with the type of material and is usually chosen to give the apparent ionization within the chamber that would be obtained in air. The type of gas used and its pressure will also vary this factor.

It is noted in the drawing that the two separate radiation detectors share the same gas, since the outer shell 11 of the Geiger-Müller counter is open into the larger chamber. This gives the Geiger-Müller counter a considerably greater reserve of gas and a correspondingly longer life than is possible in a standard tube of the size of tube 11. The gas used may be chosen primarily for the Geiger-Müller counter and the outer ionization chamber designed for best service with this particular gas.

The center terminal in the preferred embodiment of this invention, as shown here, is positive and the outer terminal is negative in both the ionization chamber and the Geiger-Müller counter. This is not essential, although it appears to give better results.

The ionization chamber 9 may have its own separate anode (not shown), if for any reason this is desirable, or it may share the anode 14 of the Geiger-Müller counter, extended beyond the tube 11.

Since the current flow in the ionization chamber may be very minute, the leakage across the surface of the end 7 may be appreciable. To overcome this the metal ring 26 may be embedded in the end 7 to form a continuous path around terminal 12 so that there is no surface path between terminals 10 and 12. This ring should be grounded.

What is claimed is:

1. A radiation detector comprising a first radiation detector in which ionization is amplified due to a gas multiplication phenomena and current flow is substantially proportionate to the number of times the radiation is sufficient to cause ionization, first indicating means for said first detector, a second radiation detector in which ionization is not amplified and current flow is substantially proportionate to the radiation causing the ionization, second indicating means for said second detector, a gas mixture common to both said detectors, a source of electrical potential, switching means to connect said first detector and indicating means in series with said source of electrical potential in a first position and to connect said second detector and indicating means in series with said source of electrical potential in a second position.

2. A radiation counter comprising; in combination, a first radiation detector in which ionization is amplified due to a gas multiplication phenomena and current flow is substantially proportionate to the number of times the radiation is sufficient to cause ionization, a second radiation detector in which ionization is not amplified and current flow is substantially proportionate to the radiation

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causing the ionization, a gas mixture common to both said detectors, a source of voltage, switching means to connect said source of voltage to said first detector in a first position and to said second detector in a second position.

3. A radiation counter comprising a first radiation detector in which ionization is amplified due to a gas multiplication phenomena and current flow is substantially proportionate to the number of times the radiation is sufficient to cause ionization, having two electrodes, a second radiation detector in which ionization is not amplified and current flow is substantially proportionate to the radiation causing the ionization, having two electrodes, a gas mixture common to said detectors one of said electrodes of said first detector serving as one of said electrodes of said second detector, a source of electric potential, switching means to connect said source of electrical potential to said first detector in a first position and to said second detector in a second position.

4. An hermetically sealed tubular dielectric enclosure, a gaseous medium within said enclosure, a first tubular electrode within said enclosure adjacent the inner wall thereof and having a terminal extending through a first end wall of said enclosure, a second tubular electrode mounted concentrically within said first tubular electrode and having a terminal extending through said first end wall of said enclosure, a third cylindrical electrode mounted concentrically within said first and second tubular electrodes and having a terminal extending through said first end of said enclosure, the spacing between said first and second electrodes being of the order of several magnitudes as compared to the spacing of the second and third electrodes, a source of voltage, a first indicator means, a second indicator means and means including switch means to connect said source and said first indicator means across said first and second electrodes in one position thereof and to connect said source and said second indicator means across said second and third electrodes in another position thereof.

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