United States Patent

[11] 3,603,831

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[21] Appl. No. **757,384**
[22] Filed **Sept. 4, 1968**
[45] Patented **Sept. 7, 1971**
[32] Priority **Sept. 13, 1967**
[33] **Germany**
[31] **P 16 14 002.0**

[54] RADIATION DETECTOR WITH GAS-PERMEABLE RADIATION WINDOW

2 Claims, 2 Drawing Figs.

[52] U.S. Cl. 313/93, 250/83.6
[51] Int. Cl. H01j 39/26
[50] Field of Search ..... 313/93; 250/83.6 FT

[56] References Cited

UNITED STATES PATENTS

2,499,830	3/1950	Molloy	250/83.6 FT
2,509,700	5/1950	Simpson, Jr.	313/93 X
2,837,656	6/1958	Hendee et al.	250/83.6 FT
2,978,602	4/1961	Barnothy	313/93
3,132,249	5/1964	Maggio et al.	313/93 X

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ABSTRACT: A detector for ionizing radiation of relatively low energy of the type in which a normally nonionized gas in a chamber connects two high-voltage electrodes and is ionized by radiation entering the chamber through a window in the chamber wall relatively permeable to the radiation, is provided with a window of fine wire gauze and continuously supplied with gas under a pressure sufficient to prevent entry of contaminants from the environment through the openings in the gauze. The screen window is more permeable to low-energy radiation than known windows.

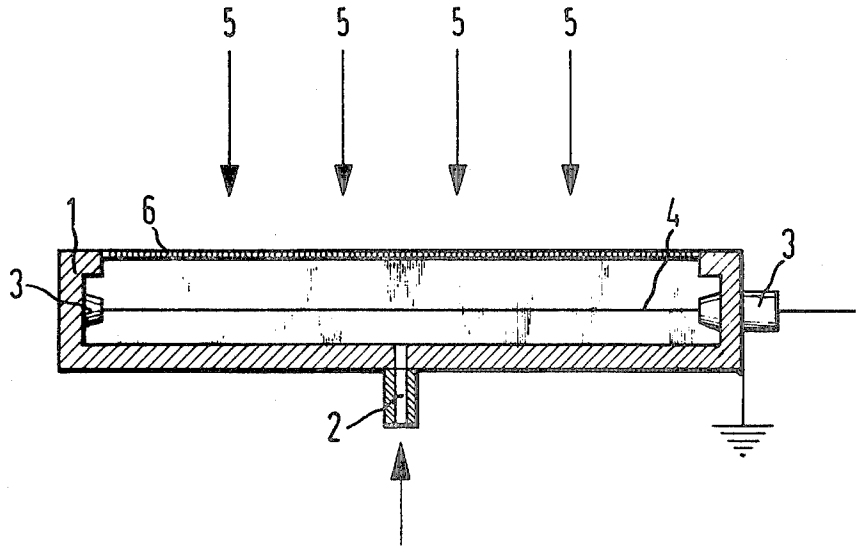


Fig. 1

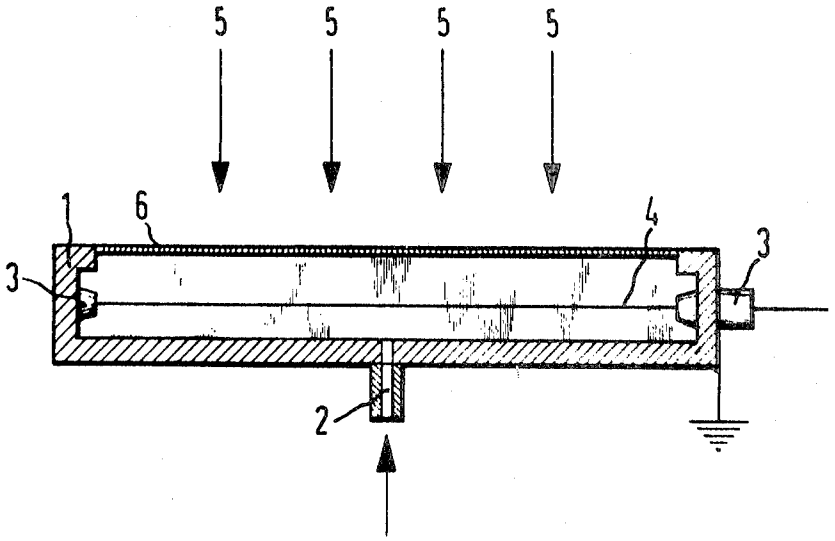
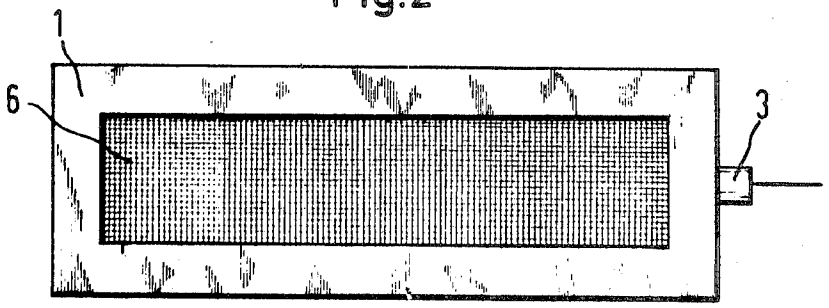


Fig. 2



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RADIATION DETECTOR WITH GAS-PERMEABLE RADIATION WINDOW

BACKGROUND OF THE INVENTION

This invention relates to the detection and measurement of ionizing radiation of relatively low energy.

The detectors employed heretofore for this purpose have a gas-filled chamber in which two electrodes are connected to a source of electric potential. A window, more permeable to the radiation than the remainder of the chamber wall, is formed by a gastight metal foil or the like to permit entry of the radiation into the chamber and its ionizing action on the gas.

The known detectors are limited in their sensitivity by the absorption of very weak radiation in the material of the window. No known detector can reliably measure the radiation caused by the radioactive decay of tritium, for example. It would be necessary to remove even the foil from the window, thus permitting the gas to escape from the chamber.

The object of the invention is the provision of a radiation detector of the general type described above whose sensitivity is higher than that of the known detectors, and adequate for measuring the radiation generated by tritium decay.

SUMMARY OF THE INVENTION

It has now been found that a detector useful for measuring radiation of extremely low energy level and relying on ionization of a gas can be obtained by replacing the foil window in the known detector by a screen of conductive material having a multiplicity of minute openings therein to connect the detector chamber with the outside.

The openings in the screen permit passage of even extremely weak radiation while sufficiently impeding gas flow to prevent harmful dilution of the gas in the chamber by the ambient atmosphere during a measuring operation.

Such dilution is reduced to insignificant amounts over any reasonable period if the gas in the chamber is replenished at a deed rate sufficient to maintain a pressure differential across the screen, the pressure in the chamber being higher than at the external ends of the openings in the screen.

The exact nature of this invention as well as other objects and advantages thereof will be readily apparent from consideration of the following specification relating to the annexed drawing. BRIEF DESCRIPTION OF THE DRAWING

In the drawing:

FIG. 1 shows a detector of the invention in elevational section; and

FIG. 2 is a plan view of the detector of FIG. 1. DESCRIPTION OF THE PREFERRED EMBODIMENT

The illustrated detector has an outer metal wall 1 which bounds a chamber of rectangular prismatic shape. A nipple 2 at the bottom center of the wall 1 is connected with a nonillustrated pump. Insulators 3 centered in opposite short and narrow portions of the wall 1 carry therebetween a wire electrode 4, about 38 microns in diameter. The top portion of the wall 1 has a large opening covered by a flat wire gauze screen 6 of phosphor bronze.

The screen is woven from two groups of parallel, round wires of 35-micron diameter which intersect each other at right angles and leave therebetween openings of 38-micron size. The screen presents a surface of approximately 1/3 open spaces and 2/3 metal to radiation directed against the screen 6 at right angles as indicated by arrows 5.

The electrical circuit of the illustrated detector has been represented in the drawing only by an external lead to the wire electrode 4 and by a grounding lead connected to the wall 1. The manner in which an electric potential is applied to the two electrodes in the chamber and the measuring circuit employed for evaluating the ionizing effect of the radiation on the gas in the chamber are known in themselves and do not require further explanation.

Phosphor bronze is a convenient material of construction for the screens of the invention because the thin wires required for the best screens of this invention, that is, those having a thickness of less than 100, and preferably less than 50microns thickness, have to be woven into screens by hand, no mechanical equipment being available at this time to produce wire gauze from such fine wires. The wires are subject to mechanical stresses during weaving and should not readily oxidize while in use. Phosphor bronze meets these requirements, but good screens can also be made from austenitic stainless steel. Good results have also been obtained with metallized fine nylon yarns.

Wires much heavier than 100 microns cannot be used without producing an undesirable collimator effect by excluding radiation incident on the screen at an oblique angle. Heavier wire also reduces the total available aperture area of the screen and thereby lowers the sensitivity of the detector. I am not aware of a lower limit to the size of wires which could be used in the screens of this invention, and finer wires will be used and can be expected to give better results as the skill of the weavers improves or as mechanical equipment becomes available.

I have also produced screens by methods other than weaving, as by electrolytic deposition (electroforming) and by selective etching, and such screens may be employed although they do not compare favorably with the best wire screens as described above.

A gas or gas mixture, such as methane propane, butane, or mixtures thereof with each other or with a noble gas such as argon is maintained in the ionization chamber as is usual. In order to prevent dilution and contamination of the gas by ambient air, the outward flow velocity in the screen openings must be greater that the inward diffusion rate of the air. It has been found that a pressure differential across the screen of approximately 1–25 mm. Hg. is sufficient to exclude air from the screen illustrated, and the supply of gas through the nipple 2 is controlled accordingly. Best results are obtained when the gas in the chamber is replenished at a uniform rate.

What is claimed is:

1. In a detector for ionizing radiation of low energy, the detector including a wall enclosing a chamber adapted to contain a gas, two electrodes in said chamber, conductive means for connecting said electrodes to a source of electrical potential, a portion of said wall constituting a window more permeable to said radiation than the remainder of said wall, the improvement which comprises:

   a. a flat screen constituting said one portion of said wall, said screen consisting of a plurality of groups of phosphor bronze or austenitic stainless steel wires having a transverse dimension not substantially exceeding 100 microns, the members of each group extending in a common direction and transversely intersecting the members of another group to define with the same a multiplicity of minute openings uniformly distributed in said screen in such a manner that the screen presents a surface of approximately ⅓ open space and ⅔ metal to radiation directed against the screen at right angles to said surface; and

   b. feed means for feeding a gas to said chamber at a rate sufficient to maintain a pressure differential across said screen, the pressure in said chamber being higher than at the external side of said openings,

      1. said openings constituting the sole substantial path for flow of said gas from said chamber.

2. In a detector as set forth in claim 1, said wires having a transverse dimension not substantially exceeding 50 microns.