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GEIGER-MUELLER COUNTER TUBE

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Fig. 1.

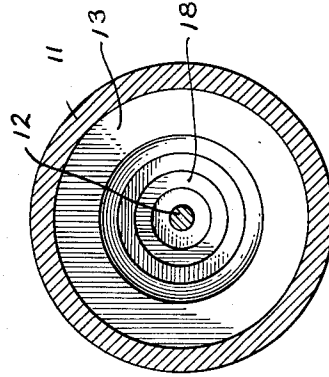
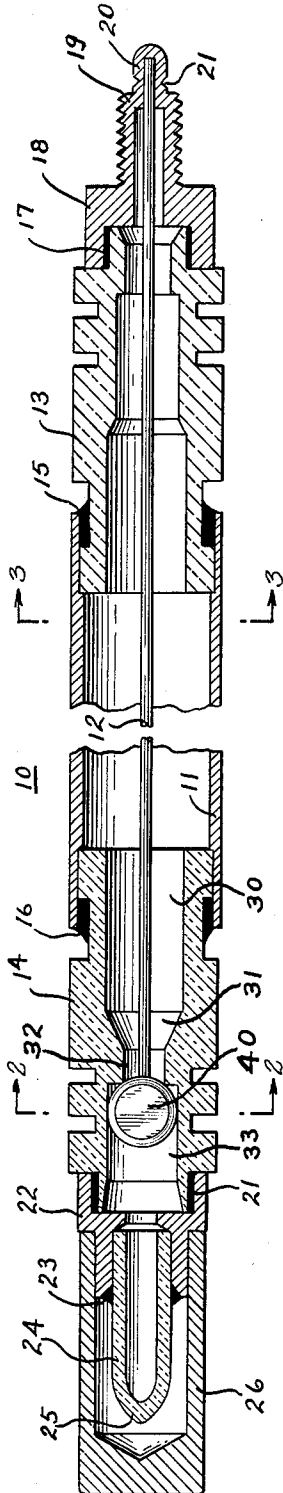


Fig. 3.

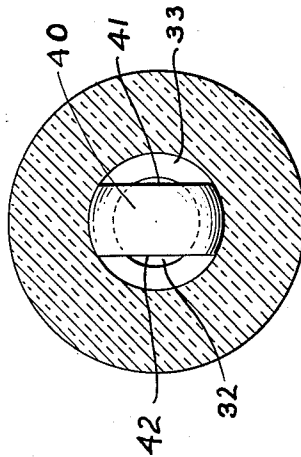


Fig. 2.

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GEIGER-MUELLER COUNTER TUBE

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4 Claims. (Cl. 313-93)

This invention relates to Geiger-Mueller counters and in particular to an improvement in the mechanical structure of such counter tubes.

The Geiger-Mueller counter, or the Geiger counter as it is commonly called, has three basic elements, the envelope, a cylindrical cathode and a coaxial anode. The physical variations in the counter may be many and one is that in which the cylindrical cathode is made of radiation permeable material and serves as the envelope of the tube as well. The tubes are generally evacuated and then a filler gas is sealed into the tube at a predetermined pressure. The filler gases themselves may be of any of a large variety, usually one of the inert gases, such as argon, neon, krypton, helium, together with the vapor of some organic chemical, such as methyl or ethyl alcohol, or a halogen or organic halide. The purpose of varying gas compositions is generally to provide for rapid quenching of the discharge when it has been initiated by penetrating radiation.

The structure of the conventional tube carries an inherent defect which is identified as microphonism and is attributed to the fact that the central anode wire is not rigidly held fixed in place within the tube, with the result that mechanical vibrations are transmitted to the wire and can produce spurious discharges or counts in the tube. Since accurate radiation measurements at low levels depend upon detecting discharges or counts above the background level, it is of fundamental importance to have tubes which have a stable background level and which do not themselves have structural qualities which contribute to that background count.

It is accordingly the basic object of this invention to provide an improved counter tube which is characterized by the fact that its background count attributable to microphonism is reduced to a low level.

It is another object of the invention to provide a method of assembling a Geiger counter tube which will produce a structure characterized by its stability and minimize microphonic counts.

The other objects and advantages of the invention will in part be obvious and in part appear hereinafter.

The invention accordingly is embodied in a Geiger counter tube characterized by its having the anode wire fixed longitudinally, the first end of the wire being fastened to the body of the tube itself, the second end being mounted without being affixed to the body of the tube, yet firmly held in place mechanically so that tension applied to the wire in the assembly is maintained, the wire at the second end being further characterized by its having a projection thereon formed to hold the wire centered in the tube. The invention therefore consists of the features of construction, combinations of elements and arrangement of parts and the method of assembling the Geiger-Mueller counter which are hereinafter described in greater detail.

The details of construction of the device may be better understood by reference to the drawing in which,

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Figure 1 is a longitudinal section through the tube showing the separate elements thereof;

Figure 2 is a section taken along the line 2-2 in Figure 1; and

Figure 3 is a section taken along the line 3-3 in Figure 1.

In the drawing, 10 represents the Geiger counter as a whole which is made with cathode cylinder 11 and anode wire 12.

Cathode cylinder 11 is sealed to insulating sections 13 and 14 at joints 15 and 16. The insulating section 13 in turn is sealed at 17 to a conductive anode support 18. In this embodiment the anode support 18 is shown having a threaded projection 19 for receiving ultimate external electrical connection. The threaded projection 19 terminates in a joint 20 which is encircled by a neck 21.

At the other end of the cylinder insulating section 14 is sealed at 21 to tubulation adapter 22, which adapter is generally of a non-conductive material. The adapter is in turn sealed at 23 to the glass tubulation 24 which is closed by its sealed end 25. The end cap 26 is fitted over the end to protect this structure.

Insulating section 14 has an interior structure which consists of a main passage 30, concentric with the cathode cylinder, which narrows down at 31 to a concentric short passage 32 which leads into an enlarged end passage 33, which may be as large in diameter as passage 30. Effectively, passage 32 becomes an orifice between passage 30 and chamber 33.

The anode wire 12 has one end thereof integrally joined with or formed into a ball or projection 40, such that one transverse diameter thereof is too large to pass through the orifice 32.

The specific form shown in Figure 1 is a ball 40 having flattened areas 41 and 42 on opposite ends of a diameter as shown in Figure 2. In this fashion the ball does not completely cover orifice 32 and evacuation of the tube through the end tubulation is possible.

For any of the seals 15, 16, 17, 21, 23, good commercial high vacuum cement will do, but preferably hermetic seals joined by fusion of powdered glass are preferred. In forming this kind of fused joint the glass wets the ceramic material of high melting point and dissolves into the oxide layer of the metal.

In assembling a tube the end which carries the exhaust tubing 24, is glass powdered, assembled with insulation section 14 and cathode cylinder 11 together with the anode wire 12 and ball 40 in place and fired. In the same firing operation, the other insulation 13 and anode terminal 18 are also fused in place. As a final step, force of about 15-20 pounds is applied to the wire, which is sufficient to force the ball at the end of the wire into position and to assure that the wire is straight and in place. As a general formula for the amount of force to use, it should be sufficient to elongate the wire slightly without exceeding its elastic limit. The wire is then crimped mechanically into place and finally fused or welded to the anode support.

Having strung the anode wire in place with the correct tension, the tube is then connected to a vacuum pump, pumped down, filled to the proper pressure with an appropriate gas mixture and sealed off at the end of the glass tube 24 to form seal 25. Following this the finished tube is completed by placing the metal end cap 26 in place.

Since temperatures of 600° C. are needed to make the fused joints, it is not possible to use spring mounts for holding the anode wire in place, because they are annealed at the sealing temperature. The ball joint and the welding of the end of the anode wire in place, as described, eliminate the danger of causing the wire to be vibrated and moved out of place.

Any change in ohmic resistance or capacity of the tube

due to vibration is recorded by the associated ratemeter or scaling equipment as a count. This type of count is identified as a spurious count.

Oil well logging operations represent a preferred field of use for tubes of this form. Many tubes are stacked within a large metal tube, appropriate scaling equipment is connected to the assembly, and the whole is lowered to the bottom of a well. It is then withdrawn at a rapid rate of speed with the result that the unit strikes the wall of the well many times during the traverse and subjects the tubes to severe vibrations. Since the natural gamma radiation of the earth formations is quite low, it is most important for good measurement to reduce microphonism to the lowest possible level.

At great depths in some wells temperatures may reach 175° C. Any microphonism introduced by changes in the tube introduced by expansion of parts would also contribute to error in measurement.

By coating the anode with rhodium or platinum or other metal of similar high atomic numbers, either using a very light electrodeposited layer or evaporated layer, variation in response of the tube due to change in temperature is substantially reduced. Similarly, improvement in this respect is obtained by coating the inside wall of the cathode with such metals.

The tubes made in accordance with this invention do not change in resistance over a temperature range from about -20° C. to +175° C. and maintain the anode and cathode in fixed relationship such that spurious counts due to microphonism are minimized.

By applying the desired tension to the wire in the initial assembly, it is possible to have the structure such that the wire is under permanent tension with no danger of vibration out of its coaxial location. Since it is common to make the cathode cylinder of metal, it is possible by having the wire of the same metal to maintain substantially constant tension on the wire regardless of the temperature at which the tube is used, because the amount of expansion or contraction will be directly proportional to the length of the tube, and this can be the same in both the shell and the anode wire. Where the cathode cylinder is not to be of the same material as the anode wire, materials having coefficients of expansion, which are close to being the same, may be utilized in order to maintain the desired relationship.

A few typical combinations of materials for use in the structure are the following:

Cathode: copper, steel, nickel.

Anode: copper, platinum, tungsten, molybdenum, zirconium.

Insulating Ends: porcelain, glass, Al Si Mag ceramic.

The anode and cathode materials and the combinations thereof may be varied greatly. Usually they are determined by the nature of the radiation to be measured.

It has been found that a Geiger counter made in ac-

cordance with this invention, i.e., with the anode wire fixed in place by holding it under tension performs with practically an undetectable degree of microphonism.

Though the invention has been described with reference to only a single embodiment, it is understood that variations thereof may be practiced without departing from its spirit or scope.

What is claimed is:

1. A Geiger-Mueller tube comprising a cylindrical cathode formed of a conductive material, a first insulated coaxial anode support at one end of said cathode, a second coaxial anode support at the opposite end of said cathode, said second support having a circular aperture therein, and a straight coaxial anode wire extending centrally through said cylindrical cathode and having an enlarged end seated in said aperture, said anode wire having an outer surface comprising a metal of high atomic weight, said anode wire further having a thermal coefficient of expansion substantially equal to that of said cylindrical cathode, said end being of generally circular cross-section larger than said aperture but with a cut-away portion so that said aperture is not fully obscured, said wire being elongated beyond its unstressed length and having its other end attached under tension to said first anode support, said wire being attached with a tension sufficient to elongate it beyond its unstressed length but substantially less than its elastic limit.

2. A Geiger-Mueller tube as claimed in claim 1 wherein said cathode is predominantly copper, said anode wire is predominantly copper, and said supports are predominantly porcelain.

3. A Geiger-Mueller tube as claimed in claim 1 wherein said cathode is predominantly steel, said anode wire is predominantly platinum and said supports are predominantly glass.

4. A Geiger-Mueller tube as claimed in claim 1, wherein said cathode is predominantly nickel, said anode wire is predominantly a metal selected from the class consisting of tungsten, molybdenum and zirconium, and said supports are predominantly ceramic.

References Cited in the file of this patent

UNITED STATES PATENTS

45	2,391,572	Herzog	Dec. 25, 1945
	2,494,641	Anderson et al.	Jan. 17, 1950
	2,512,773	Herzog	June 27, 1950
	2,521,315	Victoreen	Sept. 5, 1950
	2,522,902	Shamos	Sept. 19, 1950
50	2,532,956	Simpson	Dec. 5, 1950
	2,602,904	Simpson	July 8, 1952
	2,605,435	Krasnow et al.	July 29, 1952
	2,716,584	Retzer	Aug. 30, 1955
	2,835,839	Borzin	May 20, 1958
55	2,837,677	Hendee et al.	June 3, 1958
	2,879,423	Bayard	Mar. 24, 1959