

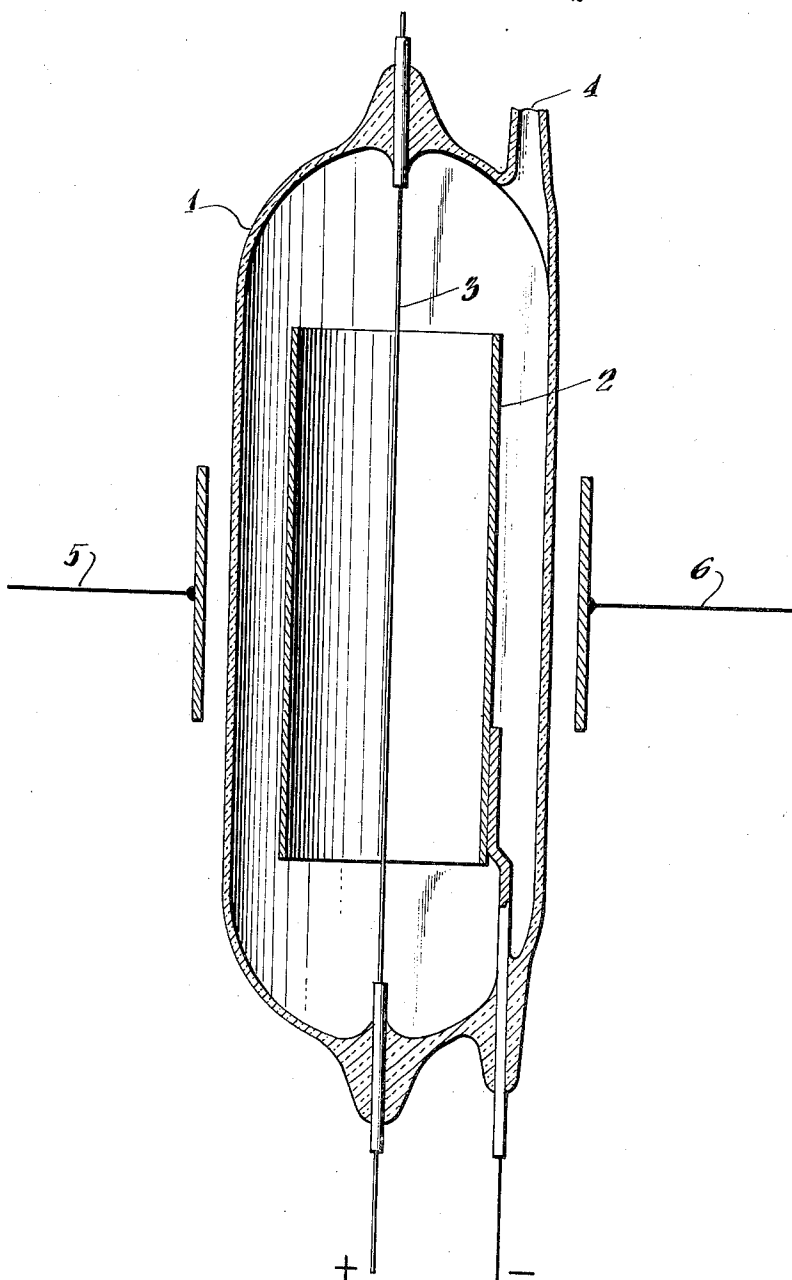
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GEIGER-MÜLLER COUNTER TUBE

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1

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GEIGER-MÜLLER COUNTER TUBE

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3 Claims. (Cl. 313—93)

In the fabrication of Geiger-Müller counter tubes one of the components, sometimes the characteristic component, of the gaseous atmosphere utilized is a hydrocarbon.

For example, in my prior patent, U. S. Patent 2,519,864, the use of gaseous fillings comprising hydrocarbons of the series C_nH_{2n+2} and C_nH_{2n} is shown, where n is from 2 to 8, inclusive, and the hydrocarbon makes up from 0.1% to 6%, approximately, of the total gas pressure. The other constituent of the disclosed atmosphere may be hydrogen, nitrogen, argon, neon, helium, etc.

Such fillings are of value for numerous reasons, but it has been observed that the use of hydrocarbon gases in closed counter tubes has resulted in relatively small life-time (frequency approximately 10^6 counts), the operation being limited by the formation of deposits. In tubes wherein the filling gas is continuously flowed through the tubes, tubes filled with mixtures comprising hydrocarbons have been used with considerable commercial success without experiencing deterioration of the counting characteristic of the tube assembly. It appears that in many cases the deposits involve decomposition products of the filling gas.

While my prior patent discloses the use of olefinic gaseous hydrocarbons, it remarks that they are not to be preferred since, when they were used the life-time of the tubes is unpredictable. It is believed that this is due to the formation of polymerization products.

This invention has for its object the provision of a Geiger-Müller counter tube assembly, closed in type, including a hydrocarbon filling gas, which has a greatly increased life-time and a substantially lessened tendency for the formation of deposits involving decomposition products of the filling gas.

It has for an object the provision of a closed type Geiger-Müller counter tube having a life expectancy and ability to maintain operating characteristics of the order of those obtained in a continuously streamed tube (where gas is flowed through), employing a filling of similar character comprising a hydrocarbon.

It has for another object the lessening of depositions formed within Geiger-Müller type counter tubes, from decomposition products of filling gases.

These and other objects may be obtained by the invention herein disclosed and claimed, which is based upon the discovery that the formation of decomposition products in the presence of hydrocarbon filling gases may be prevented by providing conditions suitable for the suppression of the formation of olefinic constituents and their subsequent polymerization to materials of higher molecular weight.

This invention involves the incorporation in a hydrocarbon filled closed tube Geiger-Müller counter of a hydrogen donor, usually gaseous hydrogen, and a material which is catalytically active to continually catalyze the hydrogenation of unsaturated hydrocarbons.

For example, it is now well known that such catalysts as metallic nickel as well as other elements of group

2

VIII of the periodic system are capable of initiating the hydrogenation of hydrocarbons at temperatures as low as room temperature. In addition to this, the mole quantities which are involved and the rate at which they need to be removed are extremely small, and only slight catalytic action is necessary to accomplish the removal of traces of unsaturated hydrocarbon. The approximate magnitude of unsaturated hydrocarbon gases in a counter tube constructed according to my prior patent and having in its initial filling only saturated hydrocarbons appears to be of the order of about 10^{-7} moles per operating day or even less. Active nickel has been reported to have velocity constants for hydrogenation of the order of 10^{-9} moles per second per square centimeter of catalyst surface at 0° C. Obviously, a properly activated nickel surface of a few square centimeters will be sufficient to accomplish the desired conversion.

According to one form of this invention, Geiger tubes are made of otherwise standard construction but incorporating at least some 10 or more sq. cm. of metallic nickel which in the course of manufacture and preparation of gas-filling of said tubes is catalytically activated by chemical reduction in the presence of hydrogen, and these tubes are filled with a hydrocarbon mixture to which is added hydrogen. An example is as follows: Nickel is introduced as the material of the cathode cylinder in the construction of the tube. The tube is then heated to a temperature of approximately 400 – 500° C. in the presence of an atmosphere of hydrogen within the tube for a period of about one hour. The hydrogen is then evacuated and the gaseous mixture is admitted consisting of approximately 200 mm. of hydrogen, 400 mm. of argon and approximately 1 to 5 mm. butane. Since some substances such as oxygen, sulphur and the like diminish or poison the catalytic activity of the metallic catalyst, every effort should be made to exclude these from the final filling. Oxygen, being the most likely poison, the inert gas and hydrocarbon filling should be treated to remove it, as by passing the inert over reduced copper, and by using hydrocarbons which have been subjected to redistillation. The tube is sealed off after filling.

The catalyst metal may be any of the usually used metallic hydrogenation catalysts, preferably nickel or platinum, and usually, nickel. It may be utilized either as one of the structural elements of the tube, for example the cathode cylinder, or in a tube having a metal wall, the wall may be of nickel. Or, other functional portions of the structure within the tube may be made of nickel. It may also be desirable, where the nickel is not so used to introduce it as powder, turnings, gauze or other form, placed within the tube so as to be accessible to the gas filling therein without being so placed as to interfere with the gas discharge.

Whatever the catalyst metal is, it is essential that it be in an active reduced state. Consequently an essential element of the preparation of a counter tube in accordance with my invention is the reducing, in situ, of the metal, before final filling and sealing off of the tube. Temperatures at which such reduction may be accomplished are well known, as are many reducing atmospheres which may be used. Of these, since it is to be used as a part of the final filling, hydrogen is obviously the most convenient. Concurrent with this is provision of a filling free from oxygen and similar poisons.

In order that this invention may be visualized, reference is now made to the single figure of the drawing which is attached to and made a part hereof. In this drawing, 1 denotes the shell of the Geiger-Müller counter tube, having a cylindrical cathode 2, made of nickel and an anode wire 3. A connection tube 4 is provided, whereby the tube may be exhausted, provided with a desired atmosphere, etc., and which may be finally

3

sealed when the tube is completed and filled. A means of heating the interior metal parts must be provided, as for example, a means of inductive heating, such as that commonly used in the "getting" or gas freeing of ordinary vacuum tubes, and is indicated diagrammatically by 5 and 6.

To finish the tube it is evacuated to a desired degree through 4 and then supplied with a hydrogen atmosphere and the metal parts, including specifically the nickel cathode 2 are inductively heated to about 400-500° C. 10 for about one hour. Then the hydrogen is evacuated and the desired atmosphere, consisting of saturated hydrocarbons, inert gas, and hydrogen is introduced, after which 4 is sealed off.

As disclosed in my prior patent, U. S. Patent 2,519,864, 15 the desirable hydrocarbon constituents of a counter atmosphere are the hydrocarbons of the saturated series C_nH_{2n+2} where n is from two to eight, inclusive. The inert component may be any of the usually chosen inert components such as argon, helium, and the like. 20

I claim:

1. A Geiger-Müller counter tube comprising an envelope, a cathode and anode mounted within said envelope, an internal atmosphere comprising hydrogen and saturated hydrocarbons of low molecular weight and substantially free of unsaturated hydrocarbons, and having 25 within said envelope an exposed surface of a reduced metal capable of catalyzing the hydrogenation of unsaturated hydrocarbons at low temperatures.

2. The article of claim 1 in which the exposed metal surface is selected from the group consisting of nickel and platinum. 30

4

3. That method for the manufacture of a Geiger-Müller counter comprising the steps of providing an envelope containing a cathode and an anode and in which there is a surface of a metal which when reduced is capable of catalyzing the hydrogenation of unsaturated hydrocarbons at low temperatures, filling the envelope with a reducing gas, heating the exposed surface of catalytic metal within said envelope in the presence of the reducing gas, whereby the metal is reduced in situ, thereafter withdrawing the reducing gas, filling the envelope with an atmosphere comprising a saturated hydrocarbon of low molecular weight and hydrogen which atmosphere is substantially free of unsaturated hydrocarbons, and sealing.

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