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A. LANGER

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ELECTRON DISCHARGE DEVICE

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Fig. 1.

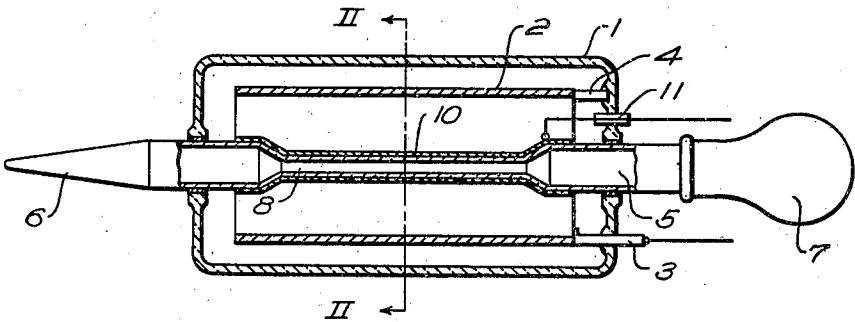


Fig. 2.

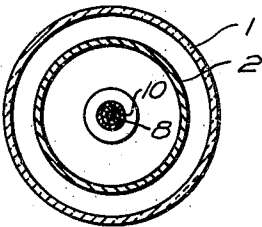
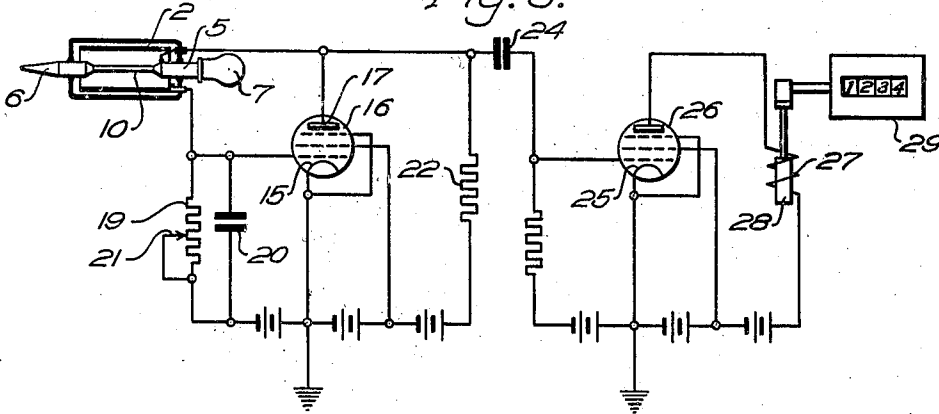


Fig. 3.



WITNESSES:

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ELECTRON DISCHARGE DEVICE

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4 Claims. (Cl. 250—83.6)

This invention relates to electronic discharge devices, and more particularly to discharge tubes known in the art as Geiger-Muller counters.

Tubes of the above type represent the most sensitive instruments known for the detection and measurement of radiations emitted by radioactive substances. They are also widely used for measuring the radiation of ultra-violet and ordinary light and cosmic rays.

Counter tubes used in the art have a variety of forms designed to suit the particular requirements in accordance with their use. The present invention contemplates a modification of the structural characteristics of such tubes, whereby their use may be extended into fields heretofore little explored, namely, the measurement of the radio activity of liquid mediums.

A particular feature of the invention is that the liquid medium to be investigated may be introduced in extremely small quantities by simple means and is held in close proximity to the active electrode area of the tube.

Another feature of the invention is that the construction of the tube in accordance therewith permits the introduction of liquids in a simple and easy manner without disturbing in the least the useful function of the device.

A particular advantage resulting from the construction herein described is that an extremely small volume of liquid may be introduced without interfering with the electrical characteristics of the device at any time during its use.

Other features and advantages will be apparent from the following description of the invention, pointed out in particularity by the appended claims and taken in connection with the accompanying drawing, in which:

Figure 1 is a side elevational view partly in cross section of the discharge device in accordance with this invention,

Fig. 2 is a cross sectional view thereof along lines II—II, and

Fig. 3 is a schematic circuit diagram showing by way of example the connection of the device of Fig. 1 in an electron counter system.

Discharge tubes of the type to which this invention relates generally consist of a metal cylinder and a thin tungsten wire extending along its axis housed in a glass vessel. The latter is evacuated and may contain a certain gas or gas mixture at a few centimeters of pressure. The cylinder and the wire serve as cathode and anode respectively. The device may be regarded as an ionization chamber supplying a pulse within a few microseconds from the time that even a

single free electron is produced inside the cylinder. The pulse is then utilized to operate or control electrical devices. Generally, the number of pulses are recorded and serve as an indication of the number of electrons which trigger the counter tube into action. It is, of course, necessary that free electrons shall penetrate within the space between anode and cathode. Since radiations have different penetrability and there are different ways for the formation of the first electron, various types of counter tubes have been developed, as stated before, for specific purposes. For example, the ordinary type of counter tube is suitable for the investigation of gamma radiation from radium and other radioactive substances, because these radiations are able to penetrate both the glass and the metal cylinder of the tube. When the radiation is of such character that it cannot penetrate with ease the wall of the vessel, certain portions thereof have been made of extreme thinness forming a window which the rays could penetrate. These type of tubes are particularly fit for work with alpha and beta rays of comparatively low energies.

The tubes of the above construction, however, are not satisfactory for analysis of radioactive liquid substances, since a small quantity of the liquid cannot be brought close enough for the radiation emitted thereby to penetrate even the thin wall structure. A discharge tube constructed in accordance with this invention solves this problem in a very simple manner. As can be seen in Fig. 1, the envelope 1, generally of glass, houses the customary cylindrical cathode electrode 2, a terminal 3 of which is brought out through the wall of the vessel and properly sealed. The cathode 2 may be supported in various ways so as to maintain its coaxial alignment at other points, for example, by the stud 4 which is sealed in the glass wall. The construction of the anode departs from standard practice in that the vessel is divided throughout its length by a tubular member 5 which has an elongated portion 6 shaped in the form of a pipette. It is coaxially positioned with respect to the cylindrical cathode 2 and its other end is provided with a rubber ball 7 whereby a liquid may be drawn into the tube when the portion 6 is dipped therein. The passage through the tube 5 is narrowed down in the middle forming a capillary portion 8. This is considerably exaggerated in the view in order to make the illustration clearer. The outer surface of the capillary tube has a thin layer of conducting material 10 along the portion which is approximately the length of the cylindrical

cathode 2. This layer may be platinum or other metal deposited by an electrical process, or in some instances it may be a thin film of solid metal. The layer 10 forms the anode of the tube and a connection therefrom is brought out to terminal 11. The cross sectional view in Fig. 2 shows the concentric arrangement of all the elements, the outer one being the vessel 1, followed by the cylindrical cathode 2, the conductive layer anode 10 and the capillary passage 8.

Referring to the application of the discharge device for a countercircuit, it is seen in Fig. 3 that the cathode 2 is connected directly to the grid 15 of an amplifier tube 16, and the anode 10 to the anode 17 thereof. The amplifier tube 16 is of the screen grid type. Proper potentials for the different electrodes of the tube 16 are shown here to be derived from batteries merely to illustrate an operative arrangement. Other types of power supplies and various types of tubes may be utilized depending upon the amplification requirements in certain applications. The grid circuit includes the grid load resistor 19 and condenser 20 in shunt therewith so proportioned as to provide a certain time constant which may be adjusted by the rider 21 of the resistor 19. The output circuit of the tube 16 includes the output load resistance 22 between anode and the high potential side of the anode supply. The effective potential between the anode 17 and cathode 15 less the comparatively small potential supplied for the bias of the grid electrode 15 will serve as the potential applied between the electrodes 2 and 10. The anode resistance 22 in series with the supply also acts as a means for stopping the current discharge between the electrodes 2 and 10. Until free electrons reach the space between anode 10 and cathode 2, the tube 1 is nonconducting. As soon as electrons produce ionization and thereby a discharge, the space current flowing there-through causes sufficient voltage drop in the resistor 22 to bring the voltage to a sufficiently low value which will stop ionization and render the tube again free to receive a succeeding impulse. The liquid medium being practically within the anode, that is, in very close proximity to the entire active inner surface of the anode area, may be regarded as being within the tube structure. The sensitivity of the tube thereby is increased to such an extent that the free elec-

trons emitted from a very small quantity of liquid, a quantity of capillary dimensions, will activate the tube. Every time sufficient free electrons are emitted, the discharge between electrodes 2 and 10 results in a pulse which is then transferred by means of the coupling through the condenser 24 to the grid 25 of a following amplifier tube 26. The latter is connected in the conventional manner as shown by the voltage supplies between its principal electrodes. The circuit thereof is standard and need not be discussed in detail. The output of the tube 26 is shown here to be connected to the energizing winding 27 of a relay 28 which operates a counter mechanism 29. Each pulse amplified by the tube 26 causes a charge plate current which will magnetize the winding 27 so that the relay will move the counter to register one unit number. The number of pulses will be directly proportional to the number of free electrons emitted by the liquid under investigation.

I claim as my invention:

1. An electric discharge vessel of the Geiger Muller type comprising a sealed envelope, an anode and a cathode electrode therein of substantially cylindrical structure concentrically disposed one within another, said anode-electrode being of smaller diameter, a support for said last-mentioned electrode substantially in contact with the entire area of the inner surface thereof, said support extending from said envelope, a passage through said support adapted to contain a liquid medium.

2. An electric discharge vessel of the Geiger Muller type in accordance with claim 1, in which said support and a portion of the passage therein form a capillary tube.

3. An electric discharge vessel of the Geiger Muller type in accordance with claim 1, in which said support and a portion of the passage therein form a capillary tube and wherein said support extends longitudinally from said envelope and is provided at one end with an elastic ball for drawing liquid through the other end into the capillary portion thereof.

4. A device in accordance with claim 1, in which said electrode of smaller diameter comprises a layer of conductive substance deposited on a portion of the outer surface of said support.

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