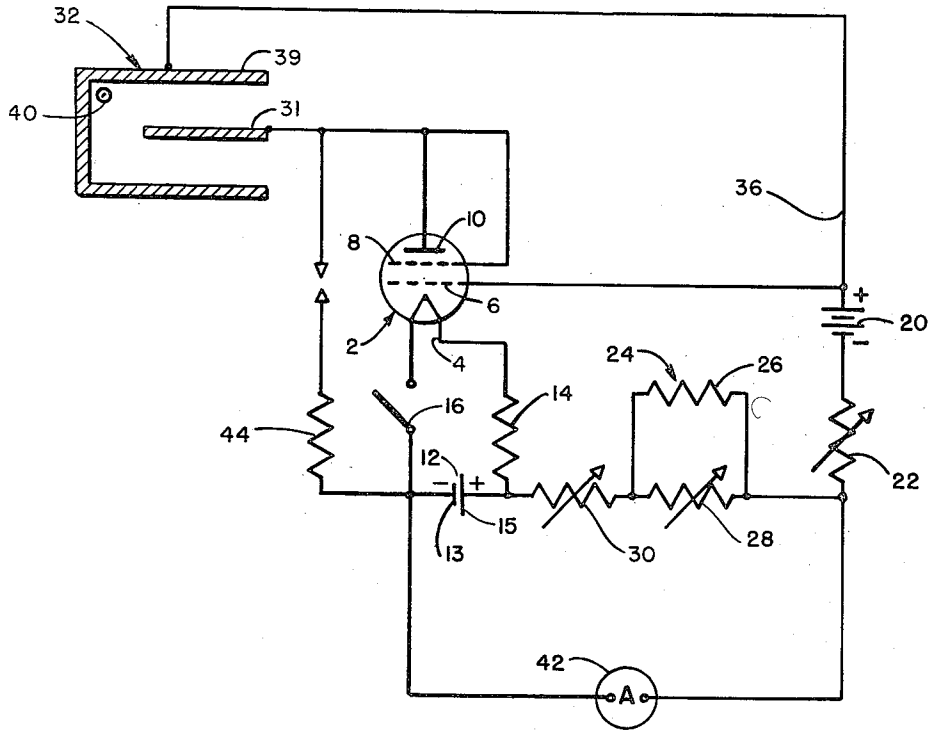
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RADIAC SURVEY METER

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RADIAC SURVEY METER

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

The present invention relates to radiation detection instruments and more particularly to radiac survey meters.

Heretofore in order to provide a circuit which will provide a logarithmic response over a relatively wide range, it has been necessary to load the input of an electron tube with a very high impedance. This type of circuit has serious limitations as many factors intervene to limit the input impedance of the tube.

It is, accordingly, an object of the present invention to provide a novel circuit capable of providing several decades of logarithmic response.

It is a further object to provide an instrument for detecting radiation wherein such a circuit is utilized to provide a wide range of sensitivity to radiation levels.

In accordance with the present invention, there is provided a radiac survey meter having a wide range of sensitivity comprising an electron tube having at least an emitting cathode, a grid biased positive with respect to the cathode and a plate, the plate being bombarded by sufficient electrons emitted by the cathode to bias it negative with respect to the cathode whereby a very high impedance is provided between the cathode and the plate. Also included is an ionization chamber having a positive ion collector electrode within said chamber which is connected to the plate and a radioactive means of predetermined intensity for bombarding the gas in said chamber to provide positive ions on the collector electrode whereby the plate is biased negatively at a selected operating point. A meter is provided in circuit with the cathode and is responsive to the output of the tube for indicating the change in plate bias potential when the ionization chamber is subjected to outside ionizing radiation.

For a better understanding of the invention together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims.

Referring now to the drawing there is shown a preferred embodiment of the present invention. A vacuum tube 2 comprises a filament type cathode 4, a control grid 6, a screen grid 8, and a plate 10, the screen grid being tied to the plate. The negative terminal 13 of a potential source 12 is connected to one end of cathode 4 through a suitable switch 16 and the positive terminal 15 of source 12 is connected to the other end of cathode 4 through a current limiting resistor 14. Grid 6 is biased positively with respect to cathode 4 by means of a potential source 20, the negative terminal of which is connected to positive terminal 15 of source 12 through a variable resistor 22, a parallel arrangement 24 of a resistor 26 and a variable resistor 28, and a variable resistor 30. Connected to plate 10 is a center electrode 31 of an ionization chamber 32, the outer walls 39 of chamber 32 being connected to grid 6 through lead 36. Within ionization chamber 32 is a radioactive source 40 such as strontium 90 or other

suitable radioactive material which may be positioned in chamber 32 in a suitable manner to control the degree of ionization therein. An indicating meter 42 is connected between the negative terminal 13 of source 12 and the junction of resistance 22 and 28. A high megohm resistor 44 connected between cathode 4 and electrode 31 may be temporarily switched into the circuit for calibration test purposes. It is readily to be noted that with plate 10 connected to center electrode 31 as shown and with grid 6 biased positive with respect to cathode 4, tube 2 is operated as an inverted triode. As is well known, plate 10 is, therefore, the control electrode therein and grid 6 is the output electrode. It is also well known that the screen grid being closer to the control grid than the plate is actually the controlling element but since it is tied to the plate, the combination of the two is hereafter referred to as the plate.

In operation, upon closing switch 16, cathode 4 emits electrons and grid 6 draws a predetermined static current. Since plate 10 is located near the grid space charge region, some of the electrons emitted by cathode 4 strike plate 10 causing it to be initially biased slightly negative with respect to cathode 4. Radioactive source 40 in ionization chamber 32 causes ionization of the gas therewithin and the positive ions produced collect on electrode 31 thereby causing a current to flow between electrode 31 and wall 39. Plate 10 is thus biased at an operating point slightly less negative than the initial negative bias. As radioactive source 40 may be positioned to control the amount of ionization in chamber 32, the bias potential of plate 10 may be raised or lowered in accordance with the degree of ionization in chamber 32 thereby controlling the amount of current drawn by grid 6. For example, decreasing the negative bias on plate 10 causes the current flow from cathode 4 to grid 6 to increase. Current from cathode potential source 12 provides a bucking action to oppose the grid current and is utilized to balance out this current and permit the setting of meter 42 at a desired reference point prior to subjecting ionization chamber 32 to outside radiation. At this point, the device is ready to measure outside radiation.

When chamber 32 is now subjected to outside radiation such as gamma radiation, the ionization of the gas in chamber 32 is increased an amount depending upon the intensity of the outside radiation. The bias of plate 10 thereby becomes more positive thus increasing the current drawn by grid 6 from cathode 4, the current increase being indicated on meter 42.

It is to be noted that plate 10 is not physically tied down with any resistance to cathode 4. However, a resistance in the order of 10^{13} ohms is maintained therebetween. Considering the diode current between cathode 4 and plate 10, an increase in radiation rate which decreases the bias negative potential applied to the plate will not cause an equal increase in the grid current because any positive charges presented to the plate are reduced logarithmically by the diode current increase. It could also be considered that ionization chamber 32 is effectively shunted by the diode action of the plate to the cathode, and the dynamic resistance of the diode is reduced in amount proportional to the logarithm of the applied signal.

To provide means for checking the operating condition of the circuit and to establish a reference point so that the grid current excursion can be made to coincide with dial readings in roentgens per hour on meter 42, high megohm resistor 44 is switched into the circuit thereby placing a fixed voltage on the plate corresponding to a gamma radiation rate off scale and to a scale mark designated as calibration point.

From the present invention, it can be seen that by using an inverted tube with a floating plate, impedance values

of a very high order are provided. With the maintaining of appropriate circuit operating points, there is thus provided a circuit which can produce many decades of logarithmic response if plate **10** is permitted to remain at very high impedance with respect to cathode **4**. An outstanding advantage of the use of floating plate circuitry is the elimination of varying grid currents which exists when vacuum tubes are used in floating grid circuitry. In the floating grid tube, due to these varying currents a resistance greater than 10^{11} ohms is difficult to use and maintain whereas with a floating plate, a resistance greater than 10^{14} ohms is readily provided. It is accordingly, evident that floating plate circuitry is applicable where dependable high impedance is desired as in situations such as logarithmic voltmeters, D. C. logarithmic amplifiers, and high megohm meters.

While there has been described what is at present considered to be the preferred embodiment of the present invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A radiation detector comprising an ionization chamber having an inner electrode, an electron tube having at least an emitting cathode, a grid biased positive with respect to said cathode, and a plate connected to said inner electrode, a radioactive source of predetermined intensity within said chamber for ionizing the gas therewithin at a fixed ionization rate whereby a fixed bias is applied to said plate, and means in circuit with said cathode for indicating the change in said plate bias when said ionization chamber is subject to outside ionizing radiation.

2. A radiation detector as in claim 1 wherein said change in plate bias results in a change in grid current proportional to the logarithm of said plate bias change.

3. A radiation detector as in claim 1 wherein said radioactive source is strontium 90.

4. A radiation detector comprising an ionization chamber having a pair of electrodes and containing therein a radioactive source, an electron tube having at least a cathode, a control grid, and a plate, said electrodes of said ionization chamber being connected respectively to the plate and grid of said electron tube, a source of bias connected between said grid and cathode to bias said grid positive with respect to said cathode, and indicating means coupled to said tube and responsive to cathode current thereof.

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