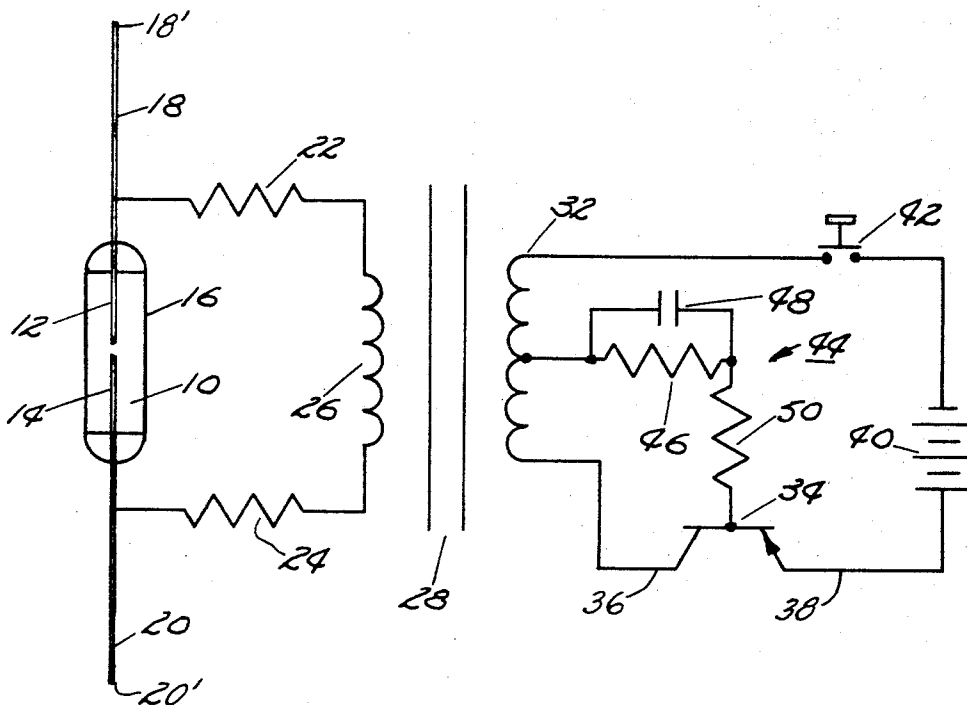


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P. H. SMITH
 DETECTOR MEANS FOR INDICATING A PREDETERMINED
 INTENSITY OF RADIATION
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INVENTOR.
Peter H. Smith
 BY
Purdickton, Neuman,
Sailor & Williams
Attys

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DETECTOR MEANS FOR INDICATING A PREDETERMINED INTENSITY OF RADIATION

Peter H. Smith, Maidenhead, England, assignor to J. Lyons & Company, Limited, London, England, a corporation of England

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ABSTRACT OF THE DISCLOSURE

This application discloses a radiation detector comprising a gas discharge tube having two electrodes connected to an antenna for coupling RF energy into the gas discharge tube. The gas within the tube is excited by an AC signal transformer coupled to the gas discharge tube. The exciting signal is sufficiently intense to ionize the gas within the tube, and when the intensity of an RF field at the antenna exceeds a predetermined value, this is marked by an increase in the intensity of the glow discharge of the gas tube and a change in the color of the glow.

This application relates to radiation detectors and particularly to radiation detectors adapted to generate a signal when in the presence of an electromagnetic field exceeding a predetermined intensity level.

Such detectors are particularly useful with respect to microwave equipment, in which high intensity radiation escaping from such equipment when in operation could be dangerous to humans. Especially in the use of microwave ovens, where high intensity radiation is employed to perform a cooking process, although the radiation level in the area in which an operator may be present may be safe when such equipment is new, due to wear and tear or accidental damage to the equipment, radiation may escape from the oven compartment such that the radiation exposure of the operator exceeds a safe upper limit.

It is therefore an important object of the present invention to provide a radiation detector adapted to indicate the presence of radiation in excess of a predetermined intensity.

Another object of the present invention is to provide such a radiation detector which is easy to operate and inexpensive in construction.

These and other objects and advantages of the present invention will become manifest upon examination of this specification and the accompanying claims and drawings.

In one embodiment of the present invention, there is provided a radiation detector having indicating means, oscillating means adapted for exciting the indicating means to produce a first indication, and means for coupling energy from an RF field to the indicating means to cause said indicating means to provide a second indication when the intensity of the RF field exceeds a predetermined level.

Reference will now be made to the accompanying drawing which is a schematic diagram of a radiation detector constructed in accordance with the present invention.

In the detector illustrated in the drawing, indicating means 10 is provided which comprises a gas discharge tube having a pair of electrodes 12 and 14 spaced apart within an envelope 16. The envelope 16 is filled with an inert gas at a relatively low pressure, and the gas is preferably neon. Electrodes 12 and 14 are each brought out through opposite ends of the tube 10, and are connected to a pair of conductors 18 and 20, respectively, which are self-supporting and extend from the tube 10 in opposite directions along a line which is common to the electrodes 10 and 12. The conductors 18 and 20 are substantially equal in length, and their ends 18' and 20' are disposed one-half

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wave length apart at the frequency of the RF field to be sensed. It is understood that the radiation detector illustrated in the drawing is intended to be used with equipment which operates at a single frequency in the microwave region, and it is this particular frequency which is desired to be sensed.

The conductors 18 and 20 constitute a half-wave dipole, and are therefore tuned to the frequency of the RF field. The conductors 18 and 20 are connected via resistors 22 and 24, respectively, to a second coil 26 of a transformer 28.

The transformer 28 is provided with a primary winding 32 which is adapted to be excited by an oscillator including a transistor 34 having emitter, collector and base terminals. The transistor 34 has its collector terminal 36 connected to one end of the primary winding 32 and its emitter terminal 38 connected to the positive terminal of a source of potential 40, which may conveniently be a battery. The negative terminal of the source 40 is connected through a push button switch 42 to the other end of the primary winding 32.

The base of the transistor 34 is connected through an RC circuit 44 to a center tap of the primary winding 32, the RC circuit 44 including a resistor 46 and a capacitor 48 connected in parallel, and a second resistor 50 connected in series with the parallel resistor 46 and capacitor 48.

The oscillator is nonoperative when the push button switch 42 is open, but oscillates at a frequency determined by the parameters of the components of the RC circuit 44 whenever the push button switch 42 is closed. The frequency of the oscillator is not critical and is conveniently in the audio range. The output of the oscillator is taken from the secondary 26 of the transformer 28 and is applied through the resistors 22 and 24 to the electrodes 12 and 14 of the tube 10. The turns ratio of the transformer 28 is such that the gas within the envelope 16 is ionized, and glows with a characteristic color. When neon is employed, for example, the color of the discharge is pink or salmon color. The amount of energy applied to the tube 10 is designed to cause the amount of ionization to be within the normal glow or the abnormal glow regions of the gas discharge characteristic, when no RF energy is coupled to the dipole 18, 20. These glow regions are well understood by those skilled in the art and are explained in detail in chapter 8 of "Gaseous Detectors" by Cobine (Dover Publications Inc., 1958). The correct level of energy to be applied to the tube 10 can readily be found by adjusting the coupling or turns ratio of the transformer 28, the voltage of the source 40, or the value of the coupling resistors 22 and 24, as will be understood by those skilled in the art.

When the RF energy coupled into the gas discharge tube 10, through the dipole 18, 20, exceeds a predetermined level, however, the ionization of the gas contained within the envelope 16 is increased and shifts into the arc glow region, which is characterized by an intense glow throughout the gas, and a change in color of the glow within the gas. When neon is used, for example, as the inert gas within the tube 10 the color of the glow changes from a pink or salmon color glow to a redder, more intense hue, and with other gases, the color may change from red to blue, etc. when the tube operates within the arc portion of the tube characteristic. It is believed that the change in the operation point from the abnormal glow portion to the arc portion is brought about by greater ionization of the gas within the tube 10 such that the bombardment of the cathode by positive ions heats the cathode sufficiently to produce thermionic excitation, whereby the voltage drop across the tube 10 is decreased and the current increases through the tube. In any event, the result is a remarkable change in color and intensity of the glow

within the tube 10 when the RF energy exceeds a predetermined threshold level.

The operating characteristic of the present invention by which the tube 10 glows without any RF energy, determines that the apparatus is functional, and furnishes a check on the operability of the detector each time it is used. Thus, there is no danger of the undetected existence of high intensity RF energy due to a faulty detector.

The energy level of the RF field which causes the operation of the tube 10 to pass over the threshold into its arc condition is dependent upon the amount of initial excitation by the oscillator including the transistor 34, which in turn is dependent upon the value of the parameters used. Proper selection of these parameters enables the detector to indicate any one of a wide range of preselected radiation intensities.

When the radiation detector is employed with microwave equipment operation operating at about 2450 megacycles, the frequency commonly employed for microwave ovens, the preferred predetermined level at which the arc portion of the tube 10 occurs is about one milliwatt per square centimeter, which is about one-tenth of the recommended maximum intensity for exposure to humans. Accordingly, the detector of the present invention may be employed to detect faulty operation of microwave equipment such as to produce leaks of radiant energy and increased radiation, to permit repair or replacement before the intensity level becomes dangerous to operators.

In one embodiment of the present invention, the components employed in the circuit illustrated in the drawings were as follows, and the increased intensity glow was observed at an RF intensity of about one milliwatt per square centimeter.

Resistor 22—470K ohms.

Resistor 24—470K ohms.

Source 40—9 volts.

Resistor 46—8.2K ohms.

Capacitor 48—0.5 μ fd.

Resistor 50—470K ohms.

The foregoing will so fully and completely describe the present invention as to enable others skilled in the art, by applying current knowledge, to adapt the same for varying conditions of service without departing from the essential items of novelty involved, which are intended to be defined and secured by the appending claims.

What is claimed is:

1. A radiation detector comprising in combination, a gaseous discharge tube having first and second electrodes aligned substantially along a common axis conductor means extending from each of said electrodes along said common axis and having the ends thereof spaced apart by approximately one-half wave length of the radiation to be detected, an oscillator including a transistor having base, emitter and collector electrodes, a source of D.C. potential, transformer means having primary and secondary windings, said primary winding being connected in series with said emitter and collector terminals and with said source, circuit means connected between said base terminal and a tap of said primary winding, and means connecting each end of said secondary winding to a different one of said electrodes, whereby said gaseous conduction tube is energized in its normal glow or its abnormal glow state by said oscillator when the intensity of said field is below a predetermined level and operates in its arc state when the intensity of said field exceeds said predetermined level.

2. A radiation detector comprising in combination, a gaseous discharge tube having first and second electrodes aligned substantially along a common axis conductor means extending from each of said first and second electrodes along said common axis and having the ends thereof spaced apart by approximately one-half wave length of the radiation to be detected, an oscillator including an amplifying element having a first amplifier electrode, a

second amplifier electrode, and a control electrode, a source of D.C. potential, transformer means having primary and secondary windings, said primary winding being connected in series with said first amplifier electrode and second amplifier electrode and with said source, circuit means connected between said control electrode and a tap of said primary winding, and means connecting each end of said secondary winding to a different one of said first amplifier electrode and second amplifier electrode, whereby said gaseous conduction tube is energized in its normal glow or its abnormal glow state by said oscillator when the intensity of said field is below a predetermined level and operates in its arc state when the intensity of said field exceeds said predetermined level.

3. A radiation detector comprising in combination, a gaseous discharge tube having first and second electrodes aligned substantially along a common axis conductor means extending from each of said electrodes along said common axis and having the ends thereof spaced apart by approximately one-half wave length of the radiation to be detected, an oscillator including a transistor having base, emitter and collector electrodes, a source of electrical potential, transformer means having primary and secondary windings, said primary winding being connected in series with said emitter and collector electrodes and with said source, circuit means connected between said base terminal and a tap of said primary winding, and means connecting each end of said secondary winding to a different one of said electrodes, whereby said gaseous conduction tube is energized in its normal glow or its abnormal glow state by said oscillator when the intensity of said field is below a predetermined level and operates in its arc state when the intensity of said field exceeds said predetermined level.

4. A radiation detector comprising in combination, a gaseous discharge tube having first and second electrodes aligned substantially along a common axis conductor means extending from each of said electrodes along said common axis and having the ends thereof spaced apart by approximately one-half wave length of the radiation to be detected, an oscillator including a transistor having base, emitter and collector electrodes, a source of D.C. potential, circuit means for connecting said source with said oscillator, transformer means having primary and secondary windings, circuit means for connecting said primary winding with said oscillator, circuit means connected between said base terminal and a tap of said primary winding, and means connecting each end of said secondary winding to a different one of said electrodes, whereby said gaseous conduction tube is energized in its normal glow or its abnormal glow state by said oscillator when the intensity of said field is below a predetermined level and operates in its arc state when the intensity of said field exceeds said predetermined level.

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RUDOLPH V. ROLINEC, *Primary Examiner*.

E. F. KARLSEN, *Assistant Examiner*.

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