

[54] IONIZATION SMOKE DETECTOR

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[22] Filed: Sept. 28, 1970
[21] Appl. No.: 76,042

[52] U.S. Cl. 250/83.6 FT, 250/44, 307/304, 340/237 S
[51] Int. Cl. G01t 1/18
[58] Field of Search 250/83.6 R, 83.6 FT, 44; 340/410, 214, 237 S; 307/304

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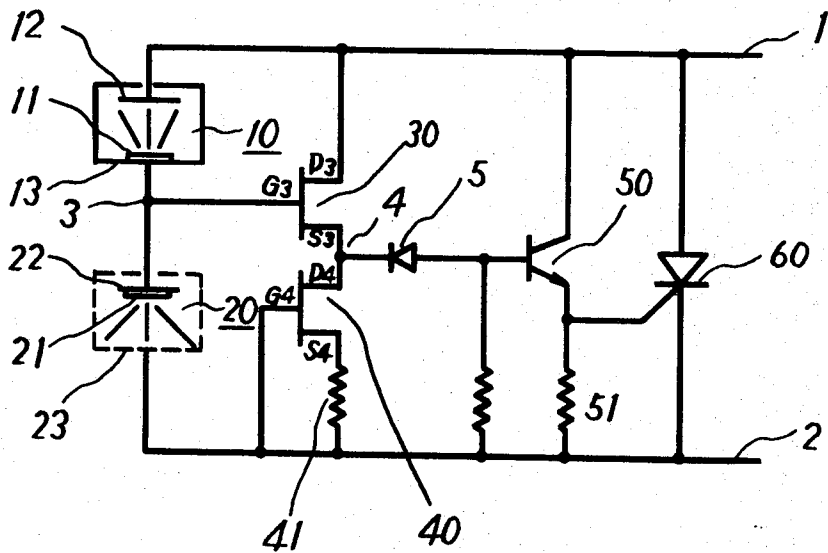
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[57] ABSTRACT

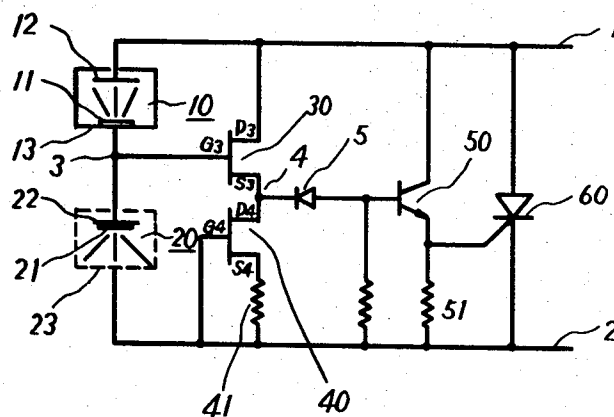
An ionization smoke detector having open and closed ionization chambers connected in series across a power supply, a field effect transistor having a gate connected to the junction of said chambers and a source-drain path connected to a power supply with current limiting means in series therewith to limit the maximum source-drain current resulting from gate leakage currents.

2 Claims, 1 Drawing Figure



PATENTED JAN 30 1973

3,714,433



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IONIZATION SMOKE DETECTOR

This invention relates to ionization smoke detectors, and, more specifically, to a novel and improved circuit for ionization smoke detectors which insures stable operation.

Ionization smoke detectors generally include a pair of ionization chambers connected in series across a voltage source. Each of said chambers includes a radioactive source and one of the chambers is closed while the other is open to the ambient air in order to permit smoke to enter the chamber. A field effect transistor has a gate electrode connected to the junction between the two chambers and the source-drain path of the transistor is connected through a load resistor across the voltage source. When smoke enters the open ionization chamber the impedance of that chamber varies with the result that a change of potential occurs at the junction between the chambers. The change in potential is detected by the transistor and produces an increase in the source-drain current which, in turn, operates an alarm device connected with the transistor.

With prior circuits for ionization detectors as described above, the source electrode of the field effect transistor is connected to the negative terminal of the voltage source only through a load resistor and there is a tendency for the source-drain current to increase with an increase in gate leakage current. Since the change in the source-drain current is similar to that produced by a potential change at the junction of the ionization chambers, faulty operation of the detector can occur. The tendency for faulty operation is substantial, particularly if the field effect transistor is of the junction type.

Accordingly, one object of the invention resides in the provision of an improved ionization smoke detector which will afford stable and reliable operation by limiting the source-drain current of the field effect transistor to a predetermined maximum value.

According to the invention, a current limiting circuit is connected in series with the source-drain path of the field effect transistor which limits the source-drain current to a value below a predetermined value. The current limiting circuit includes an additional field effect transistor having its source-drain path connected in series with a resistor and which, in turn, is connected with the source-drain path of the first transistor. The gate electrode of the current limiting transistor is connected to a terminal of the voltage source.

The above and other objects and advantages of the invention will become more apparent from the following description and accompanying drawing illustrating one embodiment of a smoke detector circuit in accordance with the invention.

Referring to the drawing, the smoke detector includes a closed ionization chamber 10 having a radioactive source 11 and a pair of electrodes 12 and 13. The open ionization chamber 20 also includes a radioactive source 21 and a pair of electrodes 22 and 23. The electrodes 12 of ionization chamber 10 and 23 of ionization chamber 20 are connected to conductors 1 and 2 which are connected to the positive and negative terminals of a suitable voltage source, not shown. The voltage source would also include means for sensing an increase in current and actuate an as-

sociated alarm device for generating an alarm signal. Power supplies and associated current sensing means and alarm devices are well-known in the art and a detailed description is not believed necessary.

The junction 3 between the electrodes 11 and 21 of the closed and open chambers, respectively, is connected to the gate electrode G-3 of the field effect transistor 30. The drain electrode D-3 is connected to the positive conductor 1 while the source electrode S-3 is connected through a zener diode 5 to the base electrode of an emitter-follower transistor 50. The transistor 50 has its collector connected to the conductor 1 and its emitter connected through a resistor 51 to the negative conductor 52. The emitter of transistor 50 is also connected to the control or gate electrode of a silicon controlled rectifier 60, the latter having its anode and cathode connected to the conductors 1 and 2 in order to provide a high current conduction path to actuate the alarm device.

A field effect transistor 40 has a drain electrode D-4 connected to the source electrode S-3 of transistor 30 at the junction 4 of the source electrode with the zener diode 5. The source electrode S-4 of transistor 40 is connected through a resistor 41 to the conductor 2. The gate electrode G-4 is also connected directly to the conductor 2. The field effect transistor 40 and the resistor 41 constitute a current limiting device in accordance with the invention.

In operation of the device, a constant voltage is applied to the conductors 1 and 2. Assuming that smoke is not present in the vicinity of the open ionization chamber 20, should the gate leakage current of the transistor 30 increase the increased source-drain current will flow through the source-drain path of transistor 40 and increase the voltage across the resistor 41. This produces a voltage drop at the gate electrode G-4 with respect to the source S-4 and this, in turn, reduces the source-drain current and limits that current to a predetermined maximum value. If the zener voltage of the zener diode 5 is selected so that it is higher than the voltage that the source electrode S-3 of transistor 30 when the source electrode S-3 attains a maximum value caused by gate leakage current, a gating signal will not be produced which could fire the silicon controlled rectifier 60 and thereby produce an alarm.

When smoke is present in the vicinity of the open ionization chamber 20, an increase in potential will occur at the junction 3 and such potential increase will be applied to the gate electrode G-3. This causes the impedance of the field effect transistor 30 to be reduced and thus raise the potential at the junction 4 above the predetermined maximum value. When this potential exceeds the critical voltage of the zener diode 5, the latter will conduct and cause a voltage to be applied to the control electrode of the silicon controlled rectifier 60 causing it to fire and thereby produce a low impedance conduction path between the conductors 1 and 2. The silicon controlled rectifier 60 draws sufficient current to actuate the alarm system, as previously described.

The emitter follower transistor 50 is provided solely for the purpose of amplifying small signals produced by the relatively small source-drain current so that it can drive the silicon controlled rectifier 60. In the event the

signal of the source electrode S-3 is of sufficient magnitude to drive the silicon controlled rectifier directly, the transistor 50 can be eliminated.

In the circuit as described above, since the current flowing through the source-drain path of the transistor 30 is always maintained at a relatively low predetermined magnitude by the current limiting circuit in accordance with the invention, the undesirable effects of gate leakage currents of the field effect transistor are removed and stable and reliable operation is obtained.

The foregoing description is for illustrative purposes and various modifications and changes may be made without departing from the scope and spirit of the invention.

What is claimed is:

1. An ionization smoke detector, comprising a closed ionization chamber having a pair of electrodes and a radioactive source therein, an open ionization chamber having a pair of electrodes and a radioactive source therein and connected in series with said closed ioniza-

tion chamber, a field effect transistor having a gate electrode connected to the junction of said ionization chambers and a source-drain conduction path connected in parallel with series connected ionization chambers, a silicon controlled rectifier having a gate electrode interconnected with and controlled by said field effect transistor and a conduction path connected in parallel with said series connected ionization chambers, means for connecting said series connected chambers to a voltage source and a constant current circuit in series with the source-drain conduction path of said field effect transistor, the last said circuit limiting the source-drain current of said field effect transistor throughout the normal gate leakage current range.

2. An ionization smoke detector, according to claim 1, wherein said constant current circuit is comprised of a second field effect transistor and a resistor connected in series with the source-drain conduction path of said second field effect transistor.

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