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(54) SMOKE SIMULATING TEST APPARATUS FOR SMOKE DETECTORS

(71) We, GENERAL ELECTRIC COMPANY, a corporation organised and existing under the laws of the State of New York, United States of America, of 1, River Road, Schenectady 12305, State of New York, United States of America, do hereby declare the invention, for which we pray that a patent may be granted to us, and the method by which it is to be performed, to be particularly described in and by the following statement:—

This invention relates to smoke detectors of the ionization type and, more particularly, to test apparatus for simulating the presence of a predetermined level of airborne products of combustion within a measuring chamber.

A smoke detector of the ionization type includes an alpha radiation source, such as a small quantity of Americium 241, in a measuring chamber having positive and negative electrodes. The measuring chamber is substantially freely accessible to the atmosphere, including airborne products of combustion. The alpha radiation in the measuring chamber ionizes the air between the electrodes, the result being the flow of a small electrical current when voltage is applied across the electrodes. When airborne products of combustion (smoke) enter the measuring chamber, they reduce the mobility of the ions and thereby increase the resistance of the measuring chamber to the flow of current. The resulting change in the electrical characteristics of the circuit containing the measuring chamber is sensed and used to trigger an alarm when the electrical change reaches a selected level representing a corresponding level of smoke or aerosols within the measuring chamber. The electrical characteristic normally sensed is the change in the voltage across the measuring chamber, the voltage change occurring as a result of the increased chamber resistance due to the presence of visible or invisible products of combustion in the measuring chamber. The sensing or alarm apparatus senses this change in voltage and triggers the alarm when the voltage change reaches the selected level.

It is essential that the smoke detector be highly sensitive and reliable in operation. It is therefore desirable that it be periodically tested to make certain that all of its operative components including the measuring chamber and the alarm apparatus are operating properly. In the past, a common way to test an ionization smoke detector has been to intentionally introduce smoke into the measuring chamber, as by blowing cigarette smoke at the detector, and to assume that everything is working properly in the event that this produces an alarm signal. This approach may not be altogether satisfactory in that there is no way to determine precisely how much smoke actually enters the chamber. For example, for adequate early warning of fires without undue false alarming in response to normal cooking fumes and the like, it is desirable that the alarm be sounded when the smoke level within the measuring chamber is in the range of 2 percent (2 parts per 100). If smoke is blown at the detector, the person testing the system does not know if the alarm has sounded in response to 2 percent smoke or 10 percent or more smoke in the measuring chamber. In other words, an ionization smoke detector may not be operating properly and still pass the "smoke" test. Another test approach has been to provide a test button which, when depressed, introduces into the alarm circuitry an electrical simulation of the measuring chamber characteristics when a predetermined level of combustion product or smoke is present within the chamber. For example, depression of the button in such a system may shunt the measuring chamber with a resistor having a resistance equal to the chamber resistance when the predetermined level of smoke is present within the chamber. It will be readily appreciated by those skilled in the art that this approach adequately tests the performance of the alarm system, but not the operation of the measuring chamber. It is extremely desirable that test means be provided for testing the entire system and all operative components including the measuring chamber

and the alarm apparatus.

In accordance with present invention there is provided a smoke detector of the ionization type comprising: a measuring chamber having an interior substantially freely accessible to airborne products of combustion, first and second spaced-apart electrodes within the measuring chamber, a source of alpha radiation for ionizing air between the first and second electrodes such that current flows between the electrodes when an appropriate voltage is applied across the electrodes, alarm means coupled to the measuring chamber for producing an alarm signal when the electrical resistance of the measuring chamber increases to a value consistent with the presence within the measuring chamber of a predetermined level of airborne products of combustion, and intercepting means for intercepting alpha particles from the source of alpha radiation, the intercepting means being movable between a normal position providing a first electrical resistance between the first and second electrodes and a test position providing a second, higher electrical resistance between the electrodes, the second higher resistance being substantially equal to the said alarm value.

In a preferred embodiment of the invention the intercepting means is electrically insulated from each of the electrodes when it is in its second position but is electrically coupled to a selected one of the electrodes when it is in its first position. The intercepting means may for example include an electrically conductive target resiliently biased into contact with the selected electrode when the intercepting means is in its first position, the target being displaced towards the source of alpha radiation against the resilient bias when the intercepting means is moved to its second position.

A detailed description of one example of the invention will now be given with reference to the accompanying drawings in which:

Figure 1 is a circuit diagram of a smoke detector incorporating a test apparatus embodying the present invention;

Figure 2 is a graph illustrating the change in voltage across the measuring chamber of Figure 1 upon either the introduction of combustion products or operation of the test apparatus of this invention;

Figure 3 is a Bragg diagram illustrating the number of ions formed as a function of the distance through which alpha particles travel from the source of radiation;

Figure 4 is a detailed view of the measuring chamber of Figure 1;

Figure 5 is a circuit diagram similar to Figure 1 illustrating the incorporation of the test apparatus in a smoke detector having a single ionization chamber; and

Figure 6 is a view similar to Figure 4 showing the intercepting means in its second position.

Referring first to Figure 1, a smoke detector 10 incorporating the test apparatus of the present invention is illustrated. The smoke detector

includes a pair of ionization chambers 12 and 14 connected in series across a pair of terminals 16 and 18 to which a suitable source of direct current power may be connected. The particular circuit illustrated is designed to be connected to a direct current battery having a voltage in the 10.5 to 12.5 volt range, the positive and negative terminals of the battery being connected to the terminals 16 and 18, respectively, as indicated. The chamber 12 is open to the atmosphere and its interior is thus freely accessible to air and airborne products of combustion or aerosols. The chamber 14 is substantially closed and its interior is thus not freely accessible to airborne products of combustion. For reasons which will become apparent as this description proceeds, the chamber 12 is a measuring chamber and the chamber 14 is a reference chamber.

As illustrated, the measuring chamber 12 includes a pair of spaced apart electrodes 20 and 22 and a source 24 of alpha radiation such as Americium 241 for ionizing the air in the interior space between the electrodes 20 and 22. As previously explained, an ion current will flow between the electrodes 20 and 22 when a voltage is applied thereacross. If aerosols or products of combustion enter the interior space of the chamber 12, the current flow will be reduced if the voltage across the electrodes is maintained constant. In other words, the introduction of combustion aerosols increases the electrical resistance of the chamber 12, the amount of resistance change being indicative of the amount of combustion products present in the chamber 12. For example, if a constant voltage V_1 as shown by Figure 2 is applied across the measuring chamber 12, an ion current I_1 will flow when there is no smoke present in the chamber, and an ion current I_1' will flow when there is 2 percent smoke present in the chamber. The reference chamber 14 includes a pair of spaced apart electrodes 26 and 28 and a source 30 of alpha radiation such as Americium 241 for ionizing oxygen and nitrogen molecules in the interior space between the electrodes 26 and 28. Since products of combustion are effectively barred from entering the interior of the chamber 14, there is substantially only one possible ion current for each voltage applied across the terminals 26 and 28 (under constant ambient atmospheric conditions). With reference to Figure 2, it will be seen that the ion current through the reference chamber 14 will be I_1'' if V_1 is applied across the terminals 26 and 28 at the assumed ambient conditions.

Ionization chambers such as the chambers 12 and 14 have characteristic curves of the type illustrated by Figure 2. The curve for each chamber has an initial generally linear slope in which there is a substantially direct relationship between applied voltage and ion current. When, however, the voltage exceeds a certain level, the chamber becomes saturated and will exhibit substantially constant current through a broad range of applied voltages. The actual configura-

tion of the characteristic curve for a chamber depends on factors such as the voltage gradient within the chamber, the strength of the alpha radiation source, and the other physical characteristics of the chamber. The basic characteristics of the chambers 12 and 14 are illustrated by the curves of Figure 2, the measuring chamber 12 being in its essentially linear condition throughout the indicated voltage range and the reference chamber reaching saturation at relatively low voltages. It is desirable in the circuit arrangement of Figure 1 that the measuring chamber 12 operate in its linear region and that the reference chamber 14 operate in its saturated region.

As illustrated by Figure 4, the source 24 of alpha radiation ionizes the air within the measuring chamber 12 within a field of radiation as indicated by the dashed lines. It is well known that the number of ions formed and the magnitude of the ion current in response to a voltage applied across the electrodes 20 and 22 are related to the distance that the alpha particles travel from the source, the relationship being shown diagrammatically by the Bragg diagram of Figure 3. As shown, the number of ions formed increases with increasing distance until a distance X, which is approximately three centimeters, is reached, after which substantially all of the energy of the alpha particles is exhausted and the formation of additional ions ceases. In the measuring chamber 12 of Figures 1 and 4, the distance between the source 24 and the electrode 20 is less than three centimeters. As a result, the maximum number of ions is produced when the alpha particles leaving the source 24 travel unhindered across the interior of the chamber. If a fixed voltage is applied across the electrodes 20 and 22, the ion current will be at its maximum level under these conditions. Stated differently, it can be said that the electrical resistance of the chamber is relatively low under these conditions. If, however, airborne products of combustion enter the chamber, collisions will occur between some of the alpha particles and the relatively heavy smoke particles, the alpha particles losing their energy in the collision and thereafter being unable to create additional ions. In addition, some ions will attach themselves to smoke particles. The result of these occurrences is a reduction in the number of ions formed, a reduction in the ion current for the fixed voltage across the electrodes, and an increase in the electrical resistance of the chamber. It will be obvious that the resistance of the chamber will increase with increasing quantities of smoke since higher levels of smoke in the chamber will result in the interception of more alpha particles.

Referring now to Figures 1 and 2, the chambers 12 and 14 are connected in series across the terminals 16 and 18 such that the substantially fixed voltage V_B of a battery connected to the terminals is applied across the circuit comprising the two chambers. Since the reference chamber

14 is intentionally designed to operate in its saturated range, it is clear that a substantially constant ion current I_1 flows through the chamber 14 at all times. Since the chambers 12 and 14 are connected in series, the same ion current I_1 will flow at all times through the measuring chamber 12. In the absence of smoke, the voltage drop across the chamber 12 will be V_2 . Similarly, the voltage drop across the chamber 12 will be V_3 when 2 percent smoke is present between its electrodes, and the voltage across the chamber 12 will be V_4 when 4 percent smoke is present. It will, of course, be obvious that the voltage across the reference chamber 14 is $V_B - V_2$ when no smoke is present, $V_B - V_3$ at 2 percent smoke and $V_B - V_4$ at 4 percent smoke. It thus will be seen that the voltage at junction 32 intermediate the chambers 12 and 14 is indicative of the level of airborne products of combustion within the chamber 12. Alarm generating circuit means are coupled to the measuring chamber 12 and the junction 32 to sense the change in voltage at the junction 32 and producing an alarm signal when the voltage is consistent with the presence of a predetermined minimum amount of smoke or the like within the chamber 12. Figures 1 and 5 disclose various forms of circuitry suitable for this purpose.

As illustrated by Figure 1, the alarm generating means includes a MOSFET field effect transistor 34 of the enhancement type having its gate coupled to the junction 32. The source of the MOSFET 34 is connected to the positive terminal 16, and the drain of the MOSFET is connected through series resistors 36 and 38 to the negative terminal 18. High gain switching means comprising a pair of cascaded SCR's are coupled to the MOSFET 34 by having the gate of the first SCR 40 connected to the junction 42 between the two series resistors 36 and 38. The cathode of the first SCR 40 is connected both to the gate of the second SCR 44 and through a resistor 46 to the negative terminal 18. The second SCR is connected in series with a horn assembly 50 across the terminals 16 and 18. A resistor 52 is provided between the anode of the first SCR 40 and the horn assembly 50. A capacitor 62 is provided across the terminals 16 and 18 to prevent rapid changes in supply voltage during sounding of the horn 50.

When there is no smoke or other airborne products of combustion within the measuring chamber 12, the voltage across the measuring chamber 12 is less than the threshold voltage of the MOSFET 34. Since the MOSFET 34 is of the enhancement type, this means that the MOSFET is OFF (not conducting) under these conditions. Since the MOSFET 34 is OFF, there is no current flow through the resistors 36 and 38 and the junction 42 is maintained at the voltage of the negative terminal 18. As a result, the first SCR 40 is also maintained in its OFF or non-conductive condition. Since the first SCR 40 is not conducting, the gate of the second SCR 44 is also maintained at the voltage of the negative

terminal 18. This means that the SCR 44 remains non-conductive and the horn 50 is not sounded. It should be noted that all elements of the sensing and switching means are turned

5 OFF under these conditions and thus will place no continuous current drain on a battery connected across the terminals 16 and 18.

If smoke or other combustion products enter the chamber 12, the voltage across the

10 chamber 12 and the source-to-gate of the MOSFET 34 increase. If the elements are selected and adjusted such that the threshold voltage of the MOSFET 34 is reached when 2 percent smoke is present in the measuring chamber 12,

15 the MOSFET will conduct when the voltage at junction 32 is consistent with the presence of at least 2 percent smoke in the chamber 12. In other words, the MOSFET 34 will conduct when-

20 ever the smoke concentration within the chamber is 2 percent or greater. Through proper selection and adjustment of the components, the MOSFET 34 can be made to initially conduct at any desired minimum amount of smoke concentration. Once the MOSFET 34 begins to

25 conduct, current will flow through the resistors 36 and 38, increasing the voltage at junction 42 sufficiently to turn on the first SCR 40. Due to the current flow through the SCR 40 and the resistor 46, the voltage on the gate of the SCR

30 44 will be sufficient to turn on the SCR 44 and thus sound the horn 50. If the smoke level in chamber 12 drops below the preselected trigger point, the voltage at the junction 32 will rise, and the voltage on the MOSFET 34 will there-

35 fore fall below the threshold level and the MOSFET 34 will turn OFF. This means that the voltage at junction 42 will also fall and the SCR 40 will turn OFF when its current falls below its holding level (due to periodic opening during

40 horn operation of the normally closed horn contacts). This in turn will cause the second SCR 44 to turn OFF both itself and the horn 50.

In Figure 5, a single ionization chamber 12' is provided in series with a resistor 72 across

45 terminals 16' and 18' for connection to an appropriate source of direct current power. If products of combustion enter the measuring chamber 12', its resistance will increase, the result being both a reduction in the ion current

50 flow through the circuit and an increase in the voltage across both the chamber 12 and the source-to-gate of a MOSFET 34'. At a predetermined minimum level of smoke in the chamber 12', the voltage at the junction 32' will drop

55 sufficiently to turn ON the enhancement mode MOSFET 34'. Conduction through the MOSFET 34' will turn on the horn 50' in the same manner as in the circuit of Figure 1. For a more detailed description of the smoke detection and alarm

60 apparatus just described with respect to Figures 1 and 5, attention is directed to our co-pending patent application 26969/76.

The test apparatus of this invention will now be described with reference to Figures 4 and 6.

65 As illustrated, the electrode 20 has a central

opening 80 which receives the lower end of a metal conductive generally cylindrical bushing 82, which has a counterbored recess 84 for receiving a flat conductive target plate 86. The target plate 86 along with a conductive stud 88

70 secured to its back form the intercepting means of the present invention. The stud 88 includes a knurled portion 90 which is force fitted into a depending shaft portion 92 of a button 94

75 located externally of the chamber 12. The shaft 92 is slidably received in the upper portion of the bushing 82, and a compression spring 96 surrounds the bushing 82 to bias the button 94 upwardly until the target plate 86 seats in the counterbored recess 84. This position as illustrated in Figure 4 will hereinafter be referred to

80 as the first position of the intercepting means. When it is desired to test the smoke detector, pressure is exerted on the button 94 to overcome the biasing spring 96 and move the intercepting means to a second position shown by Figure 6. For reasons which will become apparent as this description proceeds, the shaft 92 is formed

85 of an insulating material such as plastics, and it stops short of the target plate 86 by a distance sufficient to prevent entry of the plastics into the chamber 12 when the intercepting means is moved to its second position.

When the intercepting means is located as shown by Figure 4, the target plate 86 and the bushing 82 form with the electrode 20 an electrically continuous electrode surface across the top of the chamber 12. It may thus be said that the intercepting means does not extend

95 into the field of radiation. When, however, the intercepting means is moved to its second position as illustrated by Figure 6, the target plate 81 and the stud 88 extend into the field of radiation and intercept some of the alpha particles before they complete their journey

100 across the chamber. As a result, the amount of ionization in the chamber is reduced, and the chamber resistance increases just as it would if smoke had entered the chamber. By making the shaft 92 of insulating material, electrical conduction is prevented between the target

105 plate 86 and the electrode 20 so as to avoid any significant change in the electric field within the chamber as the intercepting means is moved out of its first position and toward its second position. In addition, by making the target plate conductive and having it

110 contact the electrode 20 through the bushing 82 when the intercepting means is in its first position, any static electricity present when the button 94 is depressed will be immediately dissipated through the electrode 20.

Referring now to Figures 1, 4 and 6, if it is desired that the alarm 50 sound when a predetermined minimum level of smoke, say 2

125 percent, is present within the measuring chamber 12, the MOSFET 34 and other alarm circuit elements are selected such that the horn will sound when the electrical resistance of the chamber 12 is consistent with the presence

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therein of the predetermined level of combustion products. Through selection of the size of the intercepting means and the precise location of the target plate 86, the resistance of the chamber when the intercepting means is in its second position and there is no smoke in the chamber can be made the same as it is when the predetermined level of combustion products are present. In this manner, depression of the button will simulate the presence of the predetermined minimum level of combustion products in the chamber by increasing the resistance of the chamber and thereby causing the alarm circuitry to sound the alarm. Under these circumstances, the sounding of the alarm indicates that not only the alarm circuitry is operating properly, but also that the chamber will respond properly when the predetermined level of smoke is present. If the alarm should not sound, it is an indication that either the alarm circuitry or the chamber itself is not operating properly.

The precise size of the target plate 86 and the stud 88 and their locations within the chamber 12 may be determined by those skilled in the art. In one embodiment of the invention, a smoke detector incorporating the test apparatus of this invention has been built and successfully operated, the detector including a measuring chamber 12 having a 1 microcurie source of Americium 241 and a reference chamber 14 having a 2 microcurie source of American 241. The chambers were adjusted to provide a saturation current of 35 pico-amperes (35×10^{-12} amperes) and a voltage of approximately 3.3 volts across the measuring chamber 12 in the absence of smoke when a battery having a voltage range of 12.5 to 10.5 volts was connected to the terminals 16 and 18. The spacing between the electrodes 20 and 22 was 0.767 centimeters to produce a voltage gradient of 5.9 volts per centimeter, and the spacing between the source 24 and the target plate 86 was 0.508 centimeters and 0.078 centimeters when the target plate 86 was in its first and second positions, respectively. The actual battery used was a Mallory Model No. 304116 having an initial voltage of 12.3 volts. The chambers 12 and 14 were further adjusted to provide a voltage of 4.3 volts, the threshold voltage of the MOSFET 34, when either the smoke level in the chamber reached 2 percent smoke or the intercepting means was moved to its second position. The MOSFET 34 was a 3 N 163, and the resistors 36 and 38 had resistance values of 27,000 and 15,000 ohms, respectively. The SCR 40 was a C 103 B and the SCR 44 was a C 103 B. The resistances of the resistors 46 and 52 were 1,000 and 6,800 ohms, respectively. The horn 50 included a commercially available horn Model 16003196, available from Delta Electric of Marion, Indiana, in parallel with a 0.01 microfarad capacitor and a 200 ohm resistor. The capacitor 62 had a capacitance of 330 microfarads.

From the foregoing, it will be seen that this

invention provides improved means for testing an ionization type smoke detector for proper operation, the test apparatus testing the entire system including the measuring chamber and the alarm apparatus. The test apparatus of this invention is capable of determining whether or not the smoke detector is operating properly when a predetermined level of smoke is present within the measuring chamber. For proper test operation, it is desirable that the intercepting means be electrically coupled to one of the chamber electrodes when it is in its first position and electrically isolated therefrom when moved from its first position.

WHAT WE CLAIM IS:—

1. A smoke detector of the ionization type comprising: a measuring chamber having an interior substantially freely accessible to airborne products of combustion, first and second spaced-apart electrodes within the measuring chamber, a source of alpha radiation for ionizing air between the first and second electrodes such that current flows between the electrodes when an appropriate voltage is applied across the electrodes, alarm means coupled to the measuring chamber for producing an alarm signal when the electrical resistance of the measuring chamber increases to a value consistent with the presence within the measuring chamber of a predetermined level of airborne products of combustion, and intercepting means for intercepting alpha particles from the source of alpha radiation, the intercepting means being movable between a normal position providing a first electrical resistance between the first and second electrodes and a test position providing a second, higher electrical resistance between the electrodes, the second higher resistance being substantially equal to the said alarm value.
2. A smoke detector of the ionization type comprising: a measuring chamber having an interior substantially freely accessible to airborne products of combustion; first and second spaced-apart electrodes within the measuring chamber; a source of alpha radiation for ionizing air between the first and second electrodes such that current flows between the electrodes when an appropriate voltage is applied across the electrodes; alarm means coupled to the measuring chamber for producing an alarm signal when the electrical resistance of the measuring chamber increases to a value consistent with the presence within the measuring chamber of a predetermined level of airborne products of combustion; intercepting means movable between a first normal position and a second test position closer to the source of alpha radiation for intercepting alpha particles, thus increasing the electrical resistance of the measuring chamber; manually operable means coupled to the intercepting means for moving the intercepting means between its first and second positions, the size of the intercepting means and the location of said second position being selected such that the electrical resistance



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therein of the predetermined level of combustion products. Through selection of the size of the intercepting means and the precise location of the target plate 86, the resistance of the chamber when the intercepting means is in its second position and there is no smoke in the chamber can be made the same as it is when the predetermined level of combustion products are present. In this manner, depression of the button will simulate the presence of the predetermined minimum level of combustion products in the chamber by increasing the resistance of the chamber and thereby causing the alarm circuitry to sound the alarm. Under these circumstances, the sounding of the alarm indicates that not only the alarm circuitry is operating properly, but also that the chamber will respond properly when the predetermined level of smoke is present. If the alarm should not sound, it is an indication that either the alarm circuitry or the chamber itself is not operating properly.

The precise size of the target plate 86 and the stud 88 and their locations within the chamber 12 may be determined by those skilled in the art. In one embodiment of the invention, a smoke detector incorporating the test apparatus of this invention has been built and successfully operated, the detector including a measuring chamber 12 having a 1 microcurie source of Americium 241 and a reference chamber 14 having a 2 microcurie source of American 241. The chambers were adjusted to provide a saturation current of 35 pico-amperes (35×10^{-12} amperes) and a voltage of approximately 3.3 volts across the measuring chamber 12 in the absence of smoke when a battery having a voltage range of 12.5 to 10.5 volts was connected to the terminals 16 and 18. The spacing between the electrodes 20 and 22 was 0.767 centimeters to produce a voltage gradient of 5.9 volts per centimeter, and the spacing between the source 24 and the target plate 86 was 0.508 centimeters and 0.078 centimeters when the target plate 86 was in its first and second positions, respectively. The actual battery used was a Mallory Model No. 304116 having an initial voltage of 12.3 volts. The chambers 12 and 14 were further adjusted to provide a voltage of 4.3 volts, the threshold voltage of the MOSFET 34, when either the smoke level in the chamber reached 2 percent smoke or the intercepting means was moved to its second position. The MOSFET 34 was a 3 N 163, and the resistors 36 and 38 had resistance values of 27,000 and 15,000 ohms, respectively. The SCR 40 was a C 103 B and the SCR 44 was a C 103 B. The resistances of the resistors 46 and 52 were 1,000 and 6,800 ohms, respectively. The horn 50 included a commercially available horn Model 16003196, available from Delta Electric of Marion, Indiana, in parallel with a 0.01 microfarad capacitor and a 200 ohm resistor. The capacitor 62 had a capacitance of 330 microfarads.

From the foregoing, it will be seen that this

invention provides improved means for testing an ionization type smoke detector for proper operation, the test apparatus testing the entire system including the measuring chamber and the alarm apparatus. The test apparatus of this invention is capable of determining whether or not the smoke detector is operating properly when a predetermined level of smoke is present within the measuring chamber. For proper test operation, it is desirable that the intercepting means be electrically coupled to one of the chamber electrodes when it is in its first position and electrically isolated therefrom when moved from its first position.

WHAT WE CLAIM IS:—

1. A smoke detector of the ionization type comprising: a measuring chamber having an interior substantially freely accessible to airborne products of combustion, first and second spaced-apart electrodes within the measuring chamber, a source of alpha radiation for ionizing air between the first and second electrodes such that current flows between the electrodes when an appropriate voltage is applied across the electrodes, alarm means coupled to the measuring chamber for producing an alarm signal when the electrical resistance of the measuring chamber increases to a value consistent with the presence within the measuring chamber of a predetermined level of airborne products of combustion, and intercepting means for intercepting alpha particles from the source of alpha radiation, the intercepting means being movable between a normal position providing a first electrical resistance between the first and second electrodes and a test position providing a second, higher electrical resistance between the electrodes, the second higher resistance being substantially equal to the said alarm value.

2. A smoke detector of the ionization type comprising: a measuring chamber having an interior substantially freely accessible to airborne products of combustion; first and second spaced-apart electrodes within the measuring chamber; a source of alpha radiation for ionizing air between the first and second electrodes such that current flows between the electrodes when an appropriate voltage is applied across the electrodes; alarm means coupled to the measuring chamber for producing an alarm signal when the electrical resistance of the measuring chamber increases to a value consistent with the presence within the measuring chamber of a predetermined level of airborne products of combustion; intercepting means movable between a first normal position and a second test position closer to the source of alpha radiation for intercepting alpha particles, thus increasing the electrical resistance of the measuring chamber; manually operable means coupled to the intercepting means for moving the intercepting means between its first and second positions, the size of the intercepting means and the location of said second position being selected such that the electrical resistance

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between the electrodes when the intercepting means is in its second position is substantially equal to the electrical resistance between the electrodes when the intercepting means is in its first position and the predetermined level of airborne products of combustion is present within the measuring chamber, whereby the presence within the measuring chamber of the predetermined level of airborne products of combustion may be simulated by moving the intercepting means to its second position so as to test the responsiveness of the alarm means.

3. A smoke detector as defined by claim 2 in which the manually operable means for moving the intercepting means comprises a button mounted externally of the measuring chamber and shaft means interconnecting the button and the intercepting means.

4. A smoke detector as defined by claim 2 or claim 2 in which the intercepting means is electrically insulated from each of the first and second electrodes at least when the intercepting means is in its second position.

5. A smoke detector as defined by claim 2 in which the intercepting means is electrically coupled to a selected one of the electrodes only when the intercepting means is in its first position, the intercepting means being electrically insulated from each of the electrodes when the intercepting means is in its section position and substantially all positions intermediate its first and second positions.

6. A smoke detector as defined by claim 5 in which the manually operable means for moving the intercepting means comprises a button mounted externally of the measuring chamber, shaft means interconnecting the button and the intercepting means, and biasing means urging the intercepting means towards its first position.

7. A smoke detector as defined by claim 6 in which the intercepting means includes an electrically conductive target contacting the selected electrode when the intercepting means is in its first position and spaced from both electrodes when the intercepting means is moved from its first position.

8. A smoke detector as defined by claim 7 in which the shaft means is an electrical insulator.

9. A smoke detector as defined by claim 8 in which only the electrically conductive target extends into the measuring chamber when the intercepting means is moved between its first and second position.

10. A smoke detector according to claim 1 and substantially as herein described with reference to the accompanying drawings.

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