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GB 1486552
GB 1434808
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GB 1099473
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(54) **Smoke detector**

(57) A smoke detector for domestic use comprises a container (2) containing a smoke chamber (20), an electrical circuit connected to an alarm (64), the chamber (20) containing a phosphorus light source (50) requiring no external source of power for activation and a pair of photocells (42) connected in series to the electrical circuit. The chamber (20) has smoke exit and entry ports (26, 32) having light shields (28, 34) and pads of porous sponge-like material (30, 36). The light beam is at 30° to the axis of chamber 20 and guide baffles (40) direct smoke transversely to the light beam. The unit is of two part construction. The integrated circuit includes a clock to actuate an LED at intervals for checking the operation.

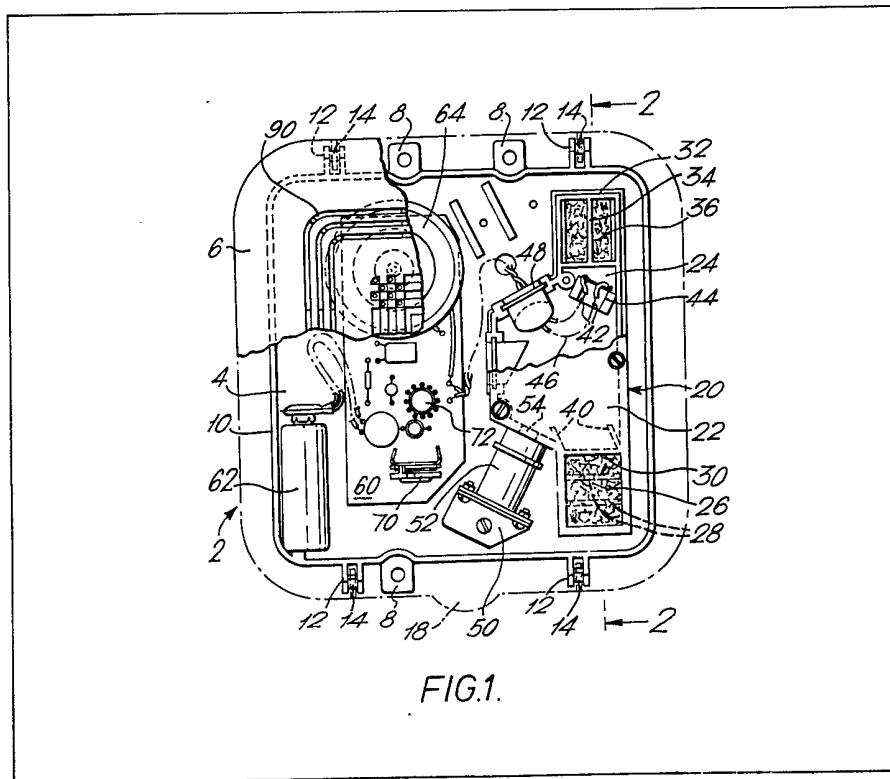


FIG.1.

The drawing(s) originally filed was/ were informal and the print here reproduced is taken from a later filed formal copy.

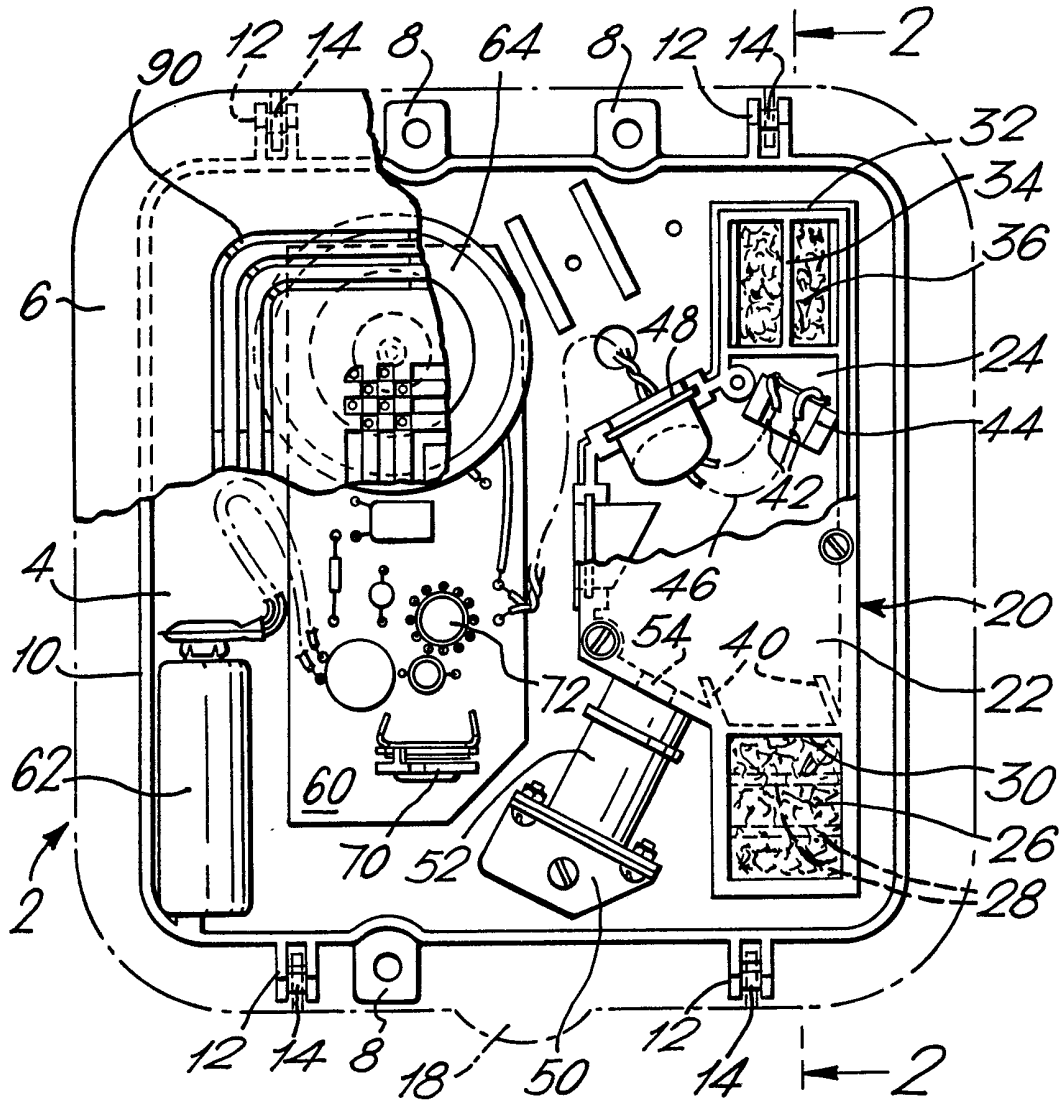


FIG. 1.

FIG. 2.

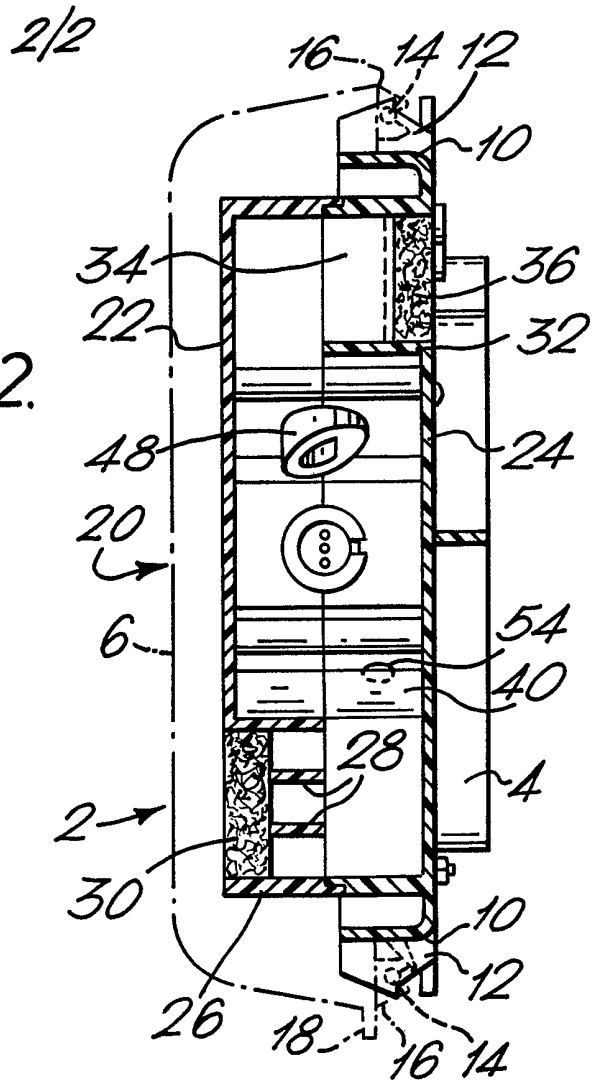
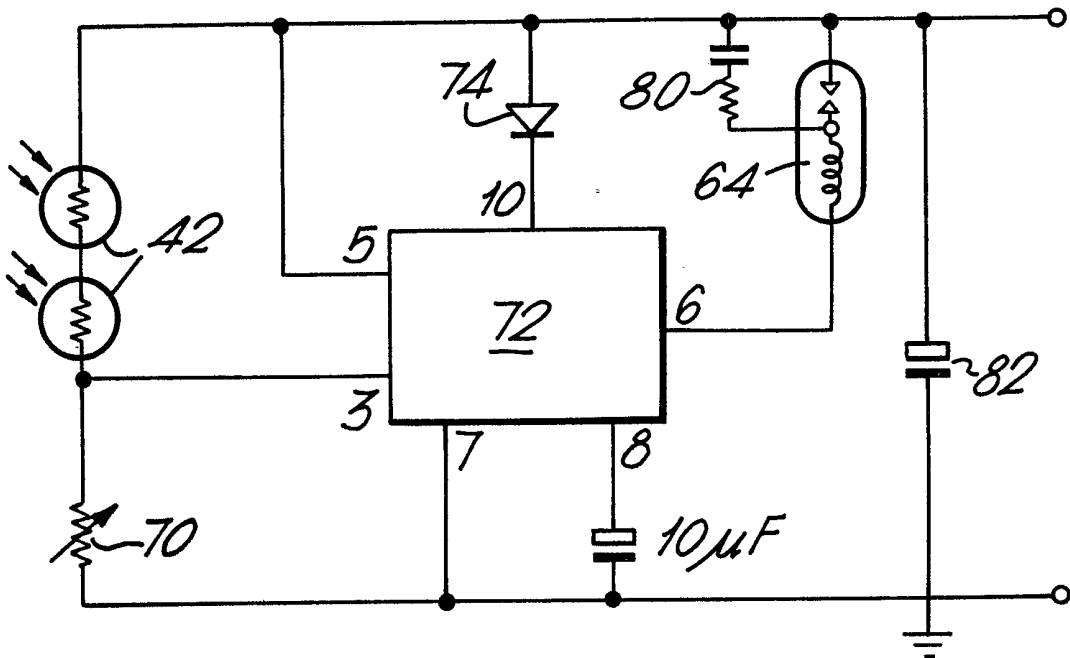


FIG. 3.



SPECIFICATION

Smoke detector

5 This invention relates to a smoke detector.

The present invention provides a smoke detector formed as a single unit and comprising a container containing a smoke chamber and an electrical circuit connected to alarm means, the smoke chamber being substantially light-tight and having entry and exit ports for smoke, a luminescent light source requiring no external source of power for activation arranged to direct light within the chamber onto photosensing means sufficiently sensitive to detect light from the light source, the photosensing means being connected to said electrical circuit such that when smoke above a predetermined level is present in said smoke chamber, said electrical circuit is effective to operate said alarm means.

20 Thus the present invention provides a smoke detector which is particularly adapted for domestic use by reason of being formed as a single unit. The smoke detector may include one or more battery cells for actuation of the electrical circuit and alarm means and may alternatively or in addition include a terminal for connection of the smoke detector to a mains supply.

Since the smoke detector in accordance with the invention employs a luminescent light source requiring no external source of power for activation, only a very small amount of power is required to maintain the smoke detector in an operative condition. It is merely necessary to provide power sufficient to maintain said electrical circuit in a quiescent condition. The light source is preferably a phosphorus light source having a long life time, for example 150 years. An additional advantage of employing a phosphorus light source is that there is no danger to persons nearby of radiation and it is in consequence unnecessary to provide any radiation shielding arrangements. A convenient form of phosphorus light source is an air-tight glass bulb having a layer of phosphorus painted on the internal surface of the bulb, the bulb containing air and oxygen, there being sufficient oxygen to allow luminescence whilst preventing spontaneous combustion of the phosphorus.

Since in accordance with the invention a luminescent light source requiring no external source of power for activation is employed, a very low level of light intensity will be produced by the source. It is therefore necessary to ensure that said photosensing means is highly sensitive to detect light from the light source. As preferred two photosensors, for example cadmium sulphide photocells, are employed connected in series to said electrical circuit.

With a very low level of light intensity from the light source, it is necessary to ensure that the smoke chamber is substantially light-tight whilst of course ensuring that flow of smoke through the smoke chamber by way of the entry and exit ports is not unduly restricted. To this end entry and exit ports are employed which are relatively large in cross-sectional area and each port has shutters positioned across the port arranged to restrict light entering the

chamber but not being such as to restrict the flow of smoke into the chamber. The entry port may include guide baffles arranged to guide smoke entering the port to an area between the light source and photosensing means.

70 As preferred for a simple and inexpensive construction of smoke chamber, the smoke chamber is formed as two parts, an upper part and a lower part, the lower part being integral with said container and the upper part being secured to the lower part. The upper part contains one of the exit and entry ports and the lower part contains the other of the entry and exit ports. The smoke chamber is preferably generally elongate with the entry and exit ports positioned at each end of the chamber, and the chamber has a central portion which is widened in a transverse direction and across which extends a light beam from the light source to the photosensing means. The arrangement is preferably such that smoke entering the entry port is directed generally transversely to the direction of light between the light source and photosensing means.

85 The container is preferably of the two part construction with a base plate mounting the components of the detector and a detachable front cover. The lower part of the smoke chamber is preferably integrally moulded with the base plate of the container. As preferred a printed circuit board is provided mounted to the base plate and the printed circuit board carries said electrical circuit together with said alarm means which is preferably in the form of an electrical buzzer.

Said electrical circuit preferably includes a variable impedance means for adjusting the predetermined level at which smoke within the smoke chamber causes the electrical circuit to be actuated. An integrated circuit is preferably provided responsive to the condition of said photosensing means for operating the alarm means. The integrated circuit is of a construction which requires a very low power consumption. Preferably a light emitting diode is provided connected to the integrated circuit for indicating that the electrical circuit is operative. The light emitting diode may be turned on intermittently by a clock within the integrated circuit to indicate the operation of the circuit.

A preferred embodiment of the invention will now be described with reference to the accompanying drawings wherein:-

115 *Figure 1* is a top plan view of the smoke detector according to the invention, with a cover plate of the detector container being partly broken away to show the internal components of the smoke detector;

Figure 2 is a cross-sectional view of the smoke detector along the line 2-2 of *Figure 1*; and

120 *Figure 3* is a circuit diagram of the smoke detector.

Referring to the drawings, the smoke detector is formed as a single unit and comprises a container 2 formed as a two part plastics moulding having a base plate 4 and a detachable cover 6. Base plate 4 is formed with apertured lugs 8 for attachment of the smoke detector to a wall or other convenient point in a house. Base plate 4 has an up-standing peripheral wall 10 within which are mounted components of

the smoke detector. Wall 10 has, extending from opposite sides thereof, pairs of projecting plates 12. Between each pair of projecting plates is disposed a pin 14.

- 5 The detachable cover is formed as a generally dish-shaped configuration and has registering with pins 14 depending peg portions 16 (see Figure 2) which clip onto pins 14 to retain the cover on the back plate. A finger grip portion 18 is provided for prising the front cover from the back plate so that when the peg portions adjacent finger grip portion 18 are prised from the corresponding pins 14, the front cover will pivot about the opposite peg portions 16 remaining on their respective pins 14.
- 10 A smoke chamber 20 is mounted within the container and comprises a two part plastics housing having an upper part 22 and a lower part 24, lower part 24 being integrally moulded with container base plate 4. Smoke chamber 20 is of generally elongate form with smoke entry and exit ports at each end, an entry port 26 being formed in the upper part 22. Entry port 26 is of rectangular cross-section and includes two shutters 28 disposed in vertical plane extending across the entry port to restrict light entering the smoke chamber. A pad of synthetic sponge-like material 30 is disposed in the entry port further to prevent light entering the entry port and to prevent large particles from entering the smoke chamber.
- 20 An exit port 32 is provided at the other end of the container and extending through the base plate 4. Exit port 32 is disposed in the lower part 24 of the smoke chamber. Exit port 32 is of rectangular shape in cross-section and has a shutter 34 disposed in a vertical plane extending lengthwise across the exit port to restrict light entering the exit port. The exit port has a pad 36 of resilient porous sponge-like synthetic material to further restrict light entering the exit port and to prevent large particles from entering the smoke chamber.

30 The central portion of smoke chamber 20 is widened as seen in Figure 1 and smoke baffles 40 are provided both in lower and upper smoke chamber parts 22 and 24 to guide smoke entering the entry port 26 into the central region of the widened central part of the smoke chamber. Positioned within the widened central part of smoke chamber 20 is a pair of cadmium sulphide photocells 42 mounted within a plastics block 44 secured to the base 4 and being connected in series with each other. Leads 46 extend from the photo-cells 42 through a blocked-off port 48 to an electric circuit to be described below.

- 40 A light source 50 is provided mounted to base 4 and enveloped in a cylinder 52 which communicates with an aperture 54 in the wall of smoke chamber 20. Light source 50 is a luminescent source requiring no external source of power for activation and comprises an air tight glass bulb 10 millimetres in diameter having a layer of phosphorus painted on the inner surface of the bulb. A mixture of air containing oxygen is provided within the bulb to supply sufficient oxygen to allow luminescence of the phosphorus, the amount of oxygen not being sufficient to permit spontaneous combustion of the phosphorus.
- 50 The life expectancy of the light source is 150 years

and the intensity of the light produced is about 1.2 mcd. The light source is a product manufactured by Merzbenteli Nuclear Inc., a Swiss company. Light source 50 and photocells 42 are positioned so that there is a relatively long light path therebetween at an angle of about 30° to the length of chamber 20.

The interior and exterior of the smoke chamber are black in colour in order to absorb light.

- A printed circuit board 60 is mounted to base plate 4, as is a single battery cell 62 of 9 volts. Printed circuit board 60 carries an electrical circuit responsive to photocells 42 and arranged to control an electromechanical buzzer 64. As shown in Figure 3 the electrical circuit comprises a variable resistor 70 connected in series across the voltage source 62 with photocells 42. Variable resistor 70 permits adjustment of the level at which the electrical circuit is operative to actuate the alarm buzzer 64. An integrated circuit 72 is provided connected to photocells 42. Integrated circuit 72 is of a type manufactured by Supertex and is numbered SD1/SD1A. The integrated circuit is a low power CMOS, the power dissipation being 300 mW and the circuit has a relative humidity range of from 5 to 95 per cent. The circuit can operate at temperatures between 0°C and 50°C. The circuit employs dual comparators, dual complementary outputs and an adjustable clock having a clock output. A light emitting diode 74 is connected to output 10 of the integrated circuit and is illuminated once every 40 seconds by the clock output of the integrated circuit to indicate the integrated circuit is operating. An output 8 of the integrated circuit is connected to a 10µF capacitor which sets the illumination period of LED 74 to 40 seconds.

The integrated circuit has a high input impedance (greater than 10^{13} ohms). The output 6 of the integrated circuit is provided by a N-channel MOS driver capable of providing a minimum of 300 ma at 1.0 volts. The output 6 is connected to a three terminal electrical buzzer of horn 64 having an external RC filter 80. A smoothing capacitor 82 is provided connected across the battery terminals.

- In operation of the smoke detector, if a fire arises, smoke will enter the smoke detector via the front cover which is apertured as at 90 with a series of parallel slots. The smoke will then enter the entry port 26 of the smoke chamber and will be guided by guide baffles 40 into the central area of the smoke detector. The light source 50 and the photocells 42 are positioned so that there is a relatively long light path extending across the smoke detector at approximately 30° to its length. A relatively long light path increases the sensitivity of the smoke detector. The smoke enters the central region and obscures the light path, the smoke subsequently leaving via exit port 32. When a sufficient amount of smoke enters the smoke detector chamber to cause the light detected by photocells 42 to decrease by a predetermined amount set by variable resistor 70, integrated circuit 72 is actuated to provide an output on terminal 6 to actuate electrical horn 64 to provide a warning alarm.

Thus it may be seen that there has been described a smoke detector of a particularly simple and

inexpensive construction which is readily adapted for domestic use and is of a very low power consumption. The electrical circuit of the smoke detector may as described employ a voltage cell for power or alternatively a terminal may be provided for connection of the smoke detector to a mains power supply. The light source in the smoke detector does not require an external source of power and has a very long life time.

CLAIMS

1. A smoke detector formed as a single unit and comprising a container containing a smoke chamber and an electrical circuit connected to alarm means, the smoke chamber being substantially light-tight and having entry and exit ports for smoke, a luminescent light source requiring no external source of power for activation arranged to direct light within the chamber on to photosensing means sufficiently sensitive to detect light from the light source, the photosensing means being connected to said electrical circuit such that when smoke above a predetermined level is present in said smoke chamber, said electrical circuit is effective to operate said alarm means.

2. A smoke detector as claimed in claim 1 wherein said light source comprises a phosphorus light source.

3. A smoke detector as claimed in claim 2 wherein said light source comprises a bulb with a layer of phosphorus disposed on an inner surface of the bulb.

4. A smoke detector as claimed in any preceding claim wherein said smoke chamber is of a two part construction having an upper part and a lower part secured together.

5. A smoke detector as claimed in claim 4 wherein said lower part is integral with a base wall of said container.

6. A smoke detector as claimed in claim 4 or 5 wherein one of said entry and exit ports is in said upper part of the smoke chamber, and the other port is in said lower part.

7. A smoke detector as claimed in any preceding claim wherein said smoke chamber is of generally elongate form with one of said exit and entry ports disposed at each end of the chamber.

8. A smoke detector as claimed in claim 7 wherein said smoke chamber has a widened central portion across which extends a light beam from said source to said photosensing means.

9. A smoke detector as claimed in claim 8 wherein said light beam is disposed obliquely to the direction of elongation of the smoke chamber.

10. A smoke detector as claimed in claim 9 wherein said light beam is disposed at approximately 30° to said direction elongation.

11. A smoke detector as claimed in any preceding claim wherein said smoke chamber includes guide baffles disposed adjacent said entry port for directing incoming smoke generally transversely to a light beam between said light source and said photosensing means.

12. A smoke detector as claimed in any preced-

ing claims wherein one or both of said entry and exit ports has one or more shutters disposed there-across, such as to restrict light entering the port but not such as to significantly hinder smoke passing through the port.

13. A smoke detector as claimed in any preceding claim wherein one or both of said exit and entry ports contains a pad of porous sponge-like material.

14. A smoke detector as claimed in any preceding claim wherein said photosensing means comprises two photosensors connected in series.

15. A smoke detector as claimed in any preceding claim including a variable resistor for adjusting the sensitivity of the electrical circuit.

16. A smoke detector as claimed in any preceding claim wherein said electrical circuit includes an integrated circuit coupled between said photosensing means and said alarm means.

17. A smoke detector as claimed in claim 16 wherein said integrated circuit includes a clocked output coupled to an LED device for indicating the integrated circuit is effective.

18. A smoke detector as claimed in any preceding claim wherein said container is of a two part construction having a front cover readily releasable from a back plate.

19. A smoke detector as claimed in claim 18 wherein said back plate mounts the components of the detector and carries mounting means for securing the detector to a wall.

20. A smoke detector as claimed in claim 18 or 19 wherein one of the front cover or back plate carries a plurality of peg portions for gripping projecting pins on the other of the front cover or back plate to provide a readily releasable means of attachment of the front cover to the back plate.

21. A smoke detector substantially as described with reference to the accompanying drawings.