A smoke detector having a design for extending from a ceiling with a low profile, and having increased accuracy of operation, has a configuration of internal walls (42, 44, 86, 116) defining a labyrinth surrounding a scatter volume for light generated by a light source (30) and sensed by light sensor (32), wherein a side wall surface (86) overhangs the source and sensor, and including first and second wall surface portions (42, 44) extending into the scatter volume from the light source and sensor and generally parallel to the light beams thereof, whereby to collimate the light beams and to prevent a direct line of sight radiation path between the source and sensor. The free ends of the wall portions (46) have knife edges defining a gap (48) therebetween. The internal surfaces of the labyrinth walls are polished and black in colour.
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SMOKE DETECTOR LABYRINTH

The present invention relates to smoke detectors.

Optical smoke detectors are known based upon the principle of having a source of infrared radiation and an infrared sensor device mounted in a housing. The source and the sensor device are arranged so that there is no direct "line of sight" between them. Instead, the source irradiates and the sensor device receives radiation from a common volume of space within the housing, herein termed the scatter volume.

Under normal conditions, the sensor device detects no light signal and therefore produces no output. Typically, the smoke detector includes a configuration of walls surrounding the scatter volume such as to define a "labyrinth" or labyrinthine path for light rays, see for example GB-A-2281619. In this way light rays from the infrared source undergo multiple reflections and are reflected out of the smoke detector via the smoke input ports, or otherwise absorbed. In addition, stray light entering the smoke detector via the smoke input ports undergoes multiple reflections and is reflected back out of the smoke detector or is otherwise absorbed. If however smoke enters the housing, infrared radiation from the source is scattered in the scatter volume by the smoke particles and some of this radiation is detected by the sensor device in order to generate an alarm signal from the smoke detector.

It will be noted that smoke detectors are normally mounted on a ceiling and that is the position in which the orientation of the smoke detector is conventionally defined. Hence the upper part of the smoke detector including a base unit is mounted to the ceiling, and the lower part of the housing including a detector unit is furthest from the ceiling. This is the convention for orientation employed in the present application.

A known smoke detector is shown in GB-A-2170597 (our Ref: PA1009), in which a labyrinth is defined by upper and lower end wall panels and a peripheral side wall surrounding the scatter volume. The walls have internal part conical surfaces defining the labyrinth so that light is reflected downwards and out of the smoke detector. A feature of this design is that smoke enters through an annular peripheral manifold. This smoke detector has been found to give a very high signal to noise ratio; it has a low level of background signal compared to its smoke threshold setting; and it is very immune to the effects of contamination. However, such smoke detector by reason of its design extends a substantial distance from the ceiling and has a "high-profile"; there is a aesthetic requirement that modern smoke detectors should be as small as possible and extend downwardly from a ceiling as little as possible; in other words, the detector should have a "low-profile".

In a smoke detector, the configuration of walls forming a labyrinth surrounding the scatter volume frequently includes a barrier to stop a direct line of sight radiation path between the radiation sensor and radiation source. Such structures create problems in providing areas in which dust or insects may settle.

Summary of the Invention

In a first aspect, the present invention provides a smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, a peripheral side wall surface, and wherein a portion the side wall surface makes an acute angle with, or forms a reentrant wall with, an adjacent end wall surface such that light emitted by the light source undergoes multiple reflections between the side wall portion and the adjacent end wall surface, for absorption into the wall surfaces.

In accordance with this first aspect of the invention the disposition of the peripheral side wall surface relative to an adjacent end wall surface is such that light rays from the light source, and stray light entering through the smoke inlet ports, is "trapped" between the two walls. The peripheral side wall makes an acute angle with the adjacent end wall surface to form a reentrant wall and, depending on the orientation, overhangs or underhangs the adjacent end wall surface. If the peripheral side wall is such that it is not possible to define a single acute angle, for example if the side wall is curved or multi-sectioned, the side wall nevertheless forms a reentrant wall with the adjacent end wall surface. Furthermore, since in use, the peripheral side wall is disposed horizontally between the upper and lower end wall surfaces, it is possible to provide a construction which is very compact in the vertical plane and thus of a low-profile.

In a preferred embodiment, the peripheral wall extends from an adjacent upper end wall surface, and is preferably formed integrally therewith, but leaves a peripheral gap, preferably completely annular, between its lower edge and the lower end wall surface. The exterior of the smoke detector preferably has an annular horizontally
disposed manifold for the inlet of smoke, and this manifold communicates with the peripheral gap to permit smoke to enter the scatter volume.

In a second aspect of the invention, there is provided a smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, and a peripheral side wall surface, wherein said surfaces are polished at least in part for accurate definition of light paths when reflected in said labyrinth.

In accordance with this second aspect of the invention since the surfaces are polished, highly accurate definition of surfaces is possible, with consequent definition of light paths in the labyrinth; a matt surface, although aiding in absorption of light rays, would create some scattering and hence a higher background light noise level.

As preferred, the smoke detector component parts are formed as plastics injection mouldings parts, and the polished surfaces are formed by highly polished die surfaces in the moulding process. As preferred, substantially all the surfaces which play a significant part in the labyrinth are polished. Further, the internal surfaces are substantially black, for absorption of the light rays.

The configuration of internal walls may include a barrier means to stop a direct line of sight radiation path between the sensor and source, and it is preferred to provide a barrier structure between the light source and sensor means. Such structures may create problems in providing areas in which dust or insects may settle, and it is a further object of the invention to reduce such problems.

In a third aspect, the present invention provides a smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, a peripheral side wall surface, and first and second wall surface portions extending between the light source and sensor means and preventing a line of sight radiation path therebetween, the first and second wall surface portions having free edges defining a gap or recess at an innermost region thereof, and at least one of the first and second wall surface portions extending generally in the beam direction of the light source or sensor device for collimation thereof.

In accordance with this third aspect of the invention, the first and second wall surface portions, projecting between the light source and sensing device, do not interfere with the compact structure of the smoke detector and thus permit the low profile to be maintained.

It has been found that a single free edge at the innermost region, defining a barrier between the light source and sensing device, has problems in that dust, stray
insects and other particulate material may settle on the free edge and cause scattering of light to the sensor means. There is therefore provided two wall surface portions each with a free edge and a gap or recess between them, one portion being closer to the light source, and the other portion being closer to the sensor means. Further, as will be explained below, the gap or recess is dimensioned such that the free edge of one wall surface portion is not in the line of sight of the sensor means or light source closer to the other wall surface portion, since otherwise unwanted crosstalk arising from scattering at the edges may occur.

As preferred a gap is provided which communicates with a smoke inlet port in a region between the two wall surface portions to allow movement of air and ingress of smoke between the two wall surface portions.

It has been found that providing a wall surface portion extending in the beam direction of the light source or sensor means has a significant advantage in that it increases the radiation reaching the scatter volume, while reducing secondary scattering. As preferred, the first wall portion extends in the direction of the light source beam and the second wall portion extends in the direction of the sensor means beam. Both beams are therefore collimated and intersect in the innermost region of the wall portions in the neighbourhood of the gap or recess. Thus this region provides a very sensitive region for the detection of smoke particles. The overall structure enables very high values of signal to noise ratios to be achieved.

As preferred, the first and/or second wall surface portions are inclined somewhat towards the respective beam to simplify the geometry.

As preferred, at least one stop wall portion is provided extending from the peripheral side wall in a position opposite the sensor means and light source across the scatter volume to inhibit secondary reflection from the light source to the sensing device.

Conveniently, the smoke detector may incorporate a means for detecting the presence of a suddendraft of hot air which is often caused by a fire and allows for earlier detection of the fire when combined with conventional smoke detection. The means used in the current invention is to have two thermistors arranged as two arms of an electrical bridge. One thermistor acting as a reference is housed inside the labyrinth and is positioned out of the airflow and the second sensing thermistor is disposed in the airflow path above the labyrinth to detect the occurrence of a draft of hot air.
Brief Description of the Drawings

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

Figure 1 and Figure 1A are exploded perspective views of the smoke detector according to the invention;
Figure 2 is a sectional view through internal parts of the assembled smoke detector showing the internal scatter volume and smoke inlet arrangement;
Figure 3 is a perspective view of an inner base member of the smoke detector;
Figure 4 is a perspective view of an inner side wall member of the smoke detector, viewed from the upper side;
Figure 5 is a perspective view of the side wall member viewed from a lower side;
Figure 6 is an enlarged sectional view of part of the side wall of the side wall member;
Figure 7 is a perspective view of an internal cap member having an upper end panel surface defining the scatter volume, viewed from an upper side;
Figure 8 is a perspective view of the internal cap member viewed from a lower side; and
Figure 9 is a diagram illustrating optical considerations of first and second wall surfaces forming a light barrier between the light source and sensor device.

Description of the Preferred Embodiment

Most commercially available smoke detectors are based on having a infrared emitter and a sensor mounted in a labyrinth. The emitter and sensor are normally mounted with stops between them so that in the normal condition no or minimal radiation from the emitter is seen by the receiver. This signal is referred to as optical crosstalk. The emitter and receiver are aligned to see a common volume of space referred to as the scatter volume. When smoke enters the labyrinth radiation from the emitter is scattered in the scatter volume and this radiation detected by the sensor used to determine that smoke is present. One of the main requirements in designing a labyrinth is to minimise background radiation due to reflections within the labyrinth. Most labyrinths use vertical chevrons to act as a means of minimising the background radiation by reflecting the incident radiation out of the labyrinth via an angled path to the outside world. The same path allows smoke entry and stops ambient light from entering the labyrinth.

The labyrinth of at least the preferred embodiment of the present invention has the following features:
1) The main reflection surfaces of the labyrinth are polished and substantially black to allow the light from the emitter beam to be controlled, directed and absorbed.  

2) The emitter beam and the receiver substantially look into a angled recess where the radiation is reflected substantially downwards and lost by reflection and absorption. The remaining beam is substantially reflected out of the labyrinth via a horizontal slot through which the smoke may enter.  

3) The angled recess is partitioned into at least two parts via a stop wall to prevent direct reflections between the light source and detector.  

4) The performance of the labyrinth may be further improved by:  
   a) the addition of a reflection wall substantially parallel to the emitter optical beam,  
   b) the addition of a reflection wall substantially parallel to the sensor optic axis.  
   c) the addition of reflection walls substantially parallel to the sensor optic axis and the emitter optical beam, with free edges at an innermost region with a gap or recess therebetween; the purpose of this geometry is explained more fully below.  

Advantages of the above are as follows:  

A) Significant lower values of optical crosstalk are obtained than has been obtained using the known chevron type labyrinth.  

B) A lower profile detector can be made than that described in GB-A-2170597.  

C) The improved labyrinth design allows very high sensitivity optical detectors to be developed.  

Referring now to the drawings and in particular to Figure 1, this shows an exploded perspective view of the smoke detector according to the invention. The smoke detector has an upper base member 10 which in use is mounted to a ceiling and containing electrical terminal means (not shown). A floor means 14 is arranged to be mounted to base member 10 and to carry internal members 16, 18 and 20 which form a labyrinth for light rays and enclose the internal scatter volume of the detector. The three inner members 16, 18, 20 are each of a one piece plastics injection moulding with inner surfaces highly polished and of a black colour. The polished surfaces are produced by using a die with highly polished surfaces. These members 16, 18 and 20 will be described in more detail below. A sealing grommet ring 22 is provided for clamping between an external cap member 24 and base 10. External cap member 24 has a peripheral annular manifold of smoke inlet ports 26 forming a fluted side wall arrangement.  

Figure 1A shows in a somewhat enlarged form the inner base end panel 16 containing the lower halves of two rectangular holders 300, 320 which serve to retain
Active optical members. Holder 300 retains an infrared diode 302 together with collimating lens 304 while holder 320 retains a light sensing device, a photo diode 322, and collimating lens 324. Holder 300, diode 302 and lens 304 together constitute a light source 30, and holder 320, diode 322 and lens 324 together constitute a light sensor means 32. In addition, two thermistors 34 and 36 may be provided for detecting the presence of heat as will be described below.

The remaining construction of the inner end base panel 16 will now be described with reference to Figure 3, wherein inner base member 16 is formed as a one piece injection plastics moulding and has a planar surface 40 which defines a wall surface defining the upper end of the labyrinth. The surface 40 is polished. The lower parts 300, 320 of the two rectangular holders are upstanding from surface 40 as are first and second inwardly extending wall surface members or portions 42, 44 which extend into the scatter volume from edges of carriers 30, 32 and terminate at knife edges 46 in a central position of the scatter volume with a gap 48 of predetermined dimensions therebetween. Knife edges 46 make a sharp angle of about 60° with the wall surfaces. Side wall surfaces 42, 44 are flat and have surfaces which are smooth and polished. The side wall surfaces 42, 44 extend generally in the direction of the light beam from the light source 30 and generally in the direction of the light reception beam of sensor means 32. The side wall surfaces 42, 44 however, make a small angle, about 10° with the direction of the light beams.

Within the holders 300, 320 are provided a series of parallel grooves 308, 328. These grooves have a matt surface and assist in defining a narrow collimated beam of light.

Panel 40 has in addition three upwardly extending lugs 62 for engaging as a snap fit in apertures in floor member 14 and in addition has three downwardly extending brackets 64 having wedge projections 66 thereon to engage in complementary apertures in side wall member 18.

Referring now to Figures 4, 5 and 6, these show in detail inner side wall member 18. Firstly, it may be seen that member 18 has spaced around its periphery a series of circular apertures 80 for receiving fixing screws, and rectangular apertures 82 for receiving bracket members 66 of member 16. Member 18 has a peripheral surface portion 84 for abutting against surface of member 16. A peripheral wall surface 86 extends downwardly from surface 84, surface 86 extending as an annulus around member 18 and having an inwardly tapering surface.

Wall surface 86 has a highly polished surface, and as shown in Figure 6, it has four annular sections 88 each making angles of 49°, 47°, 45° and 41° with surface 84, in order to approximate to a parabolic surface. As an alternative surface 86 may be wholly plane..
Extending inwardly from surface 86 are upper parts 308, 328 of the housings for the infrared light source and the light sensor and these are of counterpart shape to lower parts 300, 320 in order to make a flush connection therewith in the assembled condition to provide sealed housings for the light source and light detector. In addition, a stop wall portion 94 is provided midway between housings 308, 328 and extending radially inwardly from surface 86 into the scatter volume. As may be seen in Figure 3, a slot 96 is provided to receive the upper edge of wall 94 in order to make a mating connection therein.

As can be seen in Figure 5, the upper surface of side wall portion 18 has a series outward radially extending walls 98 with two series of peripheral wall sections 100, 102 arranged in two circles on the upper surface of wall 86, each wall section 100 being mounted between a pair of adjacent radial walls 98, and each wall section 102 being mounted in front of a respective wall 98. These walls and baffles direct smoke entry, reduce contaminants such as dust entering the chamber, and act as a light baffle.

Referring now to Figures 7 and 8, inner cap member 20 has a slotted peripheral wall 110 which defines smoke input ports 112. These ports have a fine mesh (not shown) disposed there across in order to prevent the ingress of objects such as insects, while permitting smoke to penetrate therethrough. Side wall 110 is integral with an annular portion 114 which makes an angle of 50° with wall 110 and 40° with a lower surface 116 of cap member 20 which defines a wall panel defining the lower end of the labyrinth. A hollow chimney member 120 for receiving a thermistor 34 extends to register with a hole 121 in member 16 (Figure 3), through which thermistor 34 is inserted. Chimney 120 registers with an aperture 122 in cap member 20 (Figure 8), so that thermistor 34 projects beyond surface 116 and is exposed to incoming air flow.

Referring to Figure 8, the top of cap member 20 has a series of radial rib members 124 which serve to create turbulence in the air flow passing over the labyrinth and improves the detection of hot air drafts by thermistor 34.

In the assembled condition, as shown in Figure 2 inner members 16, 18, 20 fit closely together. A labyrinth is defined by upper end surface 40, lower cap surface 116, and peripheral side wall 86, with scatter volume 150 positioned therein. Side wall 86 makes an acute angle with surface 40 and as shown, underhangs surface 40. Thus side wall 86 forms a reentrant wall with surface 40. As shown in Figure 2, smoke inlet ports 112 permit smoke to enter through a channel 160 between wall 114 of cap member 20 and the outer surface of wall 86, into the scatter volume 150. The smoke is guided in a radial direction by means of radial walls 98, and wall sections 100, 102 provide baffles for regulating the flow of smoke into the scatter volume.

Light emitted from the light diode 302 is collimated within housing 300 by means of annular grooves 308 and lens 304 and is emitted as a narrow beam of light.
A first wall surface 42 serves further to collimate the beam. Similarly, the sensing device 322 mounted within housing 320 has a narrow reception beam defined by grooves 328 within housing 32 and lens 324, and the housing beam is further collimated by wall surface 44. The two narrow beams intersect at the innermost region of walls 42, 44 in region 150, the scatter volume, adjacent knife edges 46 and gap 48.

The situation is shown schematically in Figure 9. Light is emitted by the light source 30 as a narrow beam of light 170. The light sensor means 32 has a narrow reception beam 180. The beams intersect within scatter volume 150 in front of gap 48. This is the region which is most sensitive to scattering effects and to the ingress of smoke. It may be seen from Figure 9 that the geometry of surfaces 44, 42 and the gap 48 are such that there is no direct line of sight path from light diode 302 and lens 304 to light sensing device 322 and lens 324, the closest line of sight path being indicated as 194, which touches knife edges 46 and intersects with housing portions 301, 321. It may be seen from this imaginary line of sight 194 that neither knife edge 46 is visible from the opposing optical system. Thus, the light source has no direct line of sight to knife edge 44 of second wall surface 46, and the sensor means has no direct line of sight to knife edge 46 of wall surface 42. Thus, the scattering effect of any particulate or foreign material, such as small insects, which might settle on the knife edge, will be masked at least partially from the opposing optical assembly.

The presence of gap 48 allows smoke to flow into the scatter volume 150 from smoke inlet ports 110 to the rear of walls 42, 44.

In normal use, in the absence of smoke, the light beam shines across the scatter volume 150 and is deflected by the peripheral surface 86 and then essentially undergoes multiple reflections between surface 86 and lower surface 40, around the periphery of the scatter volume. Because of the highly polished nature of the reflecting surfaces and their dimensions and angles with respect to one another, the light remains trapped, reflected between the two surfaces 86, 40 until it is eventually absorbed. In addition, stop wall 94 serves to inhibit any secondary reflection of the beam into sensor 40. In addition, light from the light beam reaching above surface 86 will be deflected off surfaces 114 and 116, and out of the detector via the smoke entry ports 112.

If smoke is present in the outer atmosphere, the smoke will ingress through the fluted ports 26 of the outer cap member and then through slots 112 of inner cap member 20 (Figures 1, 2). The closely spaced mesh across slots 112 will serve to prevent large objects ingressing. The smoke will then be directed directly radially into the scatter volume through channel 160 and over wall 84 by means of radially extending walls 98 on the upper surface of side wall member 18. Circumferential section walls 100, 102 provide a baffle to inlet smoke to control the rate at which smoke ingresses into the scatter volume.
Once having reached the scatter volume, smoke will cause the light beam to scatter in all directions and since the light beam is most intense adjacent wall 44 and gap 48, a significant proportion of this light will be forward scattered in the reception direction for sensing device 32.

For detection of sudden influx of hot air, indicative of a fire, thermistor 34 projects above surface 116. Radial ribs 124 create turbulence in the incoming airflow to aid heat transfer to the sensing thermistor 34. Chimney 120 serves to insulate the lead wires of thermistor 34 from the temperature within the labyrinth. The chimney 120 is disposed behind walls 42, 44 in order the mount the thermistor as centrally as possible but out of the way of the optics of the device. There will be a tendency for the chimney to block smoke carried into the detector from behind walls 42 44, but this is minimised by walls 42, 44 which channel the smoke through the gap between the walls and the chimney 120.

A reference thermistor 36 is located behind walls 44, 42 and close to gap 48 in order to sense the temperature within the labyrinth. The sensing thermistor 34 and the reference thermistor 36 are connected in an electrical bridge circuit (not shown). Upon a sudden influx of hot air, this is sensed by thermistor 34, but thermistor 36 will remain at the temperature of the interior of the smoke detector. In this condition, the bridge circuit will unbalance, which may be used to change the sensitivity of the smoke detector or produce an alarm.

In an alternative arrangement, gap 48 is replaced by a recess, wall surfaces 42 and 44 being formed as in integral wall structure (not shown).

It will thus be seen that, referring particularly to Figure 2, that since the scatter volume has a very narrow dimension in a direction extending downwardly from the ceiling, the smoke detector according to the present invention can be made with a particularly low profile. All the parts thereof are made of one piece injection mouldings with selectively polished surfaces, and the parts thereof are clipped together with simple spring clip connections. Hence the smoke detector, while capable of highly sensitive operation, can nevertheless be manufactured inexpensively.
CLAIMS

1. A smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, a peripheral side wall surface, and wherein a portion of the side wall surface makes an acute angle with, or forms a reentrant wall with, an adjacent end wall surface such that light emitted by the light source undergoes multiple reflections between the side wall portion and the adjacent end wall surface, for absorption into the wall surfaces.

2. A smoke detector according to claim 1, wherein the peripheral side wall surface extends from one end wall surface and defines a peripheral gap with the other end wall surface to permit smoke to ingress into the scatter volume.

3. A smoke detector according to any preceding claim, wherein said side wall surface is formed as a plurality of annular sections, each making a different angle with said adjacent side wall surface.

4. A smoke detector according to any preceding claim, wherein the aforementioned surfaces are polished at least in part for accurate definition of light paths when reflected in said labyrinth.

5. A smoke detector according to any preceding claim, wherein the aforementioned surfaces are substantially black.

6. A smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, and a peripheral side wall surface, wherein said surfaces are polished at least in part for accurate definition of light paths when reflected in said labyrinth.

7. A smoke detector according to claim 6, wherein the polished surfaces are substantially black.

8. A smoke detector according to any preceding claim, wherein said wall structure comprising first and second wall surface portions extending from a position between the light source and sensor means for preventing a direct line of sight radiation path therebetween, the first and second wall surface portions having free edges defining a gap or recess at an innermost region thereof, and at least one of the first and second wall surface portions extending generally in the beam direction of the light source or sensor device for collimation thereof.
9. A smoke detector according to claim 8, wherein the first wall portion extends generally in the direction of the light source beam, and the second wall portion extends generally in the direction of the sensor means beam for collimation thereof.

10. A smoke detector according to claim 11 or 12 wherein the first and/or second wall surface portion have surfaces which are smooth and/or polished.

11. A smoke detector having a source of light radiation, a light sensor means and a scatter volume therebetween, a configuration of internal walls enclosing the scatter volume and defining a labyrinth for light rays, the configuration comprising an upper end wall surface, a lower end wall surface, a peripheral side wall surface, and first and second wall surface portions extending into the scatter volume from a position between the light source and sensor means for preventing a direct line of sight radiation path therebetween, the first and second wall surface portions having free edges defining a gap or recess at an innermost region thereof, and at least one of the first and second wall surface portions extending generally in the beam direction of the light or sensor means for collimation thereof.

12. A smoke detector according to claim 11, wherein the first wall portion extends generally in the direction of the light source beam, and the second wall portion extends generally in the direction of the sensing device beam for collimation thereof.

13. A smoke detector according to claim 11 or 12, wherein the first and/or second wall surface portion is inclined towards the respective beam.

14. A smoke detector according to claim 11, 12 or 13, wherein the first and/or second wall surface portions have surfaces which are generally smooth and/or polished.

15. A smoke detector according to any of claims 11 to 14, wherein said free edges are straight knife edges.

16. A smoke detector according to any of claims 8 to 15, wherein the free edges are spaced such that they prevent a direct line of sight with a light source or sensor means.

17. A smoke detector according to claim 16, wherein the first wall portion is closer to the light source and the second wall portion is closer to the sensor means, and the free edges are disposed such that they prevent a direct line of sight radiation path (a) of the free edge of the first wall surface portion with the sensor means, or (b) of the free edge of the second wall surface portion with the light source.

18. A smoke detector according to any preceding claim, wherein the light source and sensor means each comprise a diode and collimating lens disposed in a housing, which includes grooves encircling the beam for collimation thereof.

19. A smoke detector according to any preceding claim, including at least one stop wall portion extending from the peripheral side wall for inhibiting secondary reflection between the light source and sensing device.
20. A detector according to claim 2 wherein the smoke detector has an outer wall with a peripheral manifold generally aligned with said peripheral gap for permitting smoke to enter the detector, and including radially disposed inner wall sections for guiding smoke to the scatter volume and circumferentially disposed inner wall sections forming baffles to control the flow of smoke into the scatter volume.

21. A smoke detector according to any preceding claim, including a heat sensor means comprising a sensing thermistor disposed in an air inlet flow passage and a reference thermistor disposed within a central region of the smoke detector.

22. A smoke detector according to claim 21, wherein the sensing thermistor has lead wires disposed in a chimney member extending to a base of the smoke detector.

23. A smoke detector according to claim 24 as dependant on claim 11, wherein the chimney member is disposed between said wall portions and a smoke inlet port.

24. A smoke detector according to any preceding claim wherein the configuration of internal walls comprises an upper base member, a peripheral side wall member, and a lower cap member, wherein each of said members is formed as a one piece plastics injection moulding, and wherein selected ones of said members carries snap fit connection means for connecting with the selected ones of the other members.

25. A smoke detector according to claim 24, wherein the peripheral side wall member carries said stop wall portion projecting radially inwardly for inhibiting secondary reflections between the light source and sensor means.

26. A smoke detector according to 24 or 25, wherein the outer surface of the peripheral side wall member carries radial side wall portions for directing the flow of smoke into the scatter volume from the exterior of the smoke detector and circumferentially disposed wall sections for controlling the flow of smoke into the scatter volume, and wherein the lower cap member has a peripheral side wall surrounding the peripheral side wall member and having a series of apertures therein for permitting smoke to flow there through.
INTERNATIONAL SEARCH REPORT

A. CLASSIFICATION OF SUBJECT MATTER

IPC 6  G08B17/107

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 6  G08B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category Citation of document, with indication, where appropriate, of the relevant passages Relevant to claim No.

A EP,A,0 227 320 (GENT LTD.) 1 July 1987
see abstract; figures 2, 3
see page 7, line 1 - line 10
see page 7, line 28 - line 30

A FR,A,2 430 049 (COFFIN) 25 January 1980
see figure 1
see page 1, line 29 - line 32

A GB,A,2 170 597 (THORN EMI PROTECH LTD.) 6 August 1986
 cited in the application
 see abstract; figure 1

Relevant to claim No. 1,5,7, 11,21,22

X Further documents are listed in the continuation of box C. X Patent family members are listed in annex.

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Date of the actual completion of the international search

6 November 1996

Date of mailing of the international search report

2 9, 11, 96

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