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(71) Applicant: **Nohmi Bosai Kogyo Co., Ltd.**
No. 7-3, Kudan Minami 4-chome
Chiyoda-ku Tokyo 102(JP)

(72) Inventor: **Orioka, Yoshiharu NOHMI BOSAI KOGYO CO., LTD.**
7-3, Kudan Minami 4-chome
Chiyoda-ku Tokyo(JP)

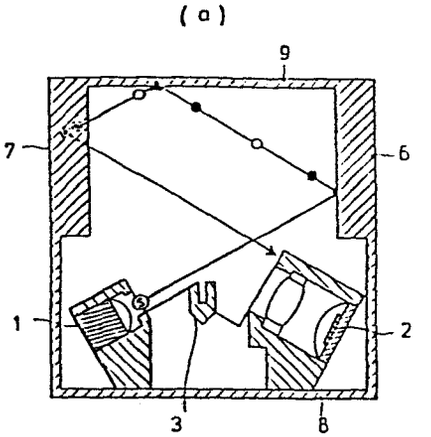
(72) Inventor: **Mochizuki, Mikio NOHMI BOSAI KOGYO CO., LTD.**
7-3, Kudan Minami 4-chome
Chiyoda-ku Tokyo(JP)

(74) Representative: **Tiemann, Ulrich, Dr.-Ing.**
c/o Cerberus AG Patentabteilung Alte Landstrasse 411
CH-8708 Männedorf(CH)

(54) Photoelectric smoke detector.

(57) The device relates to a small-sized photoelectric smoke detector in which the measuring chamber itself has a light trap function and which has a narrow measuring space. The measuring chamber is composed of a front wall (6) which reflects the light from a light emitter (1) at a predetermined angle to the optical axis of the smoke detector, side walls (4, 5) which are arranged nearly parallel with the optical axis. According to a preferred embodiment of the device the measuring chamber comprises a rear wall (7) which reflects the light reflected from the side walls (4, 5) at such an angle that the reflected light does not directly irradiate the light receiver (2). The light trap function of the measuring chamber can be further improved if the walls of the measuring chamber have mirror-like surfaces with good absorbance.

Fig. 1



EP 0 175 940 A1

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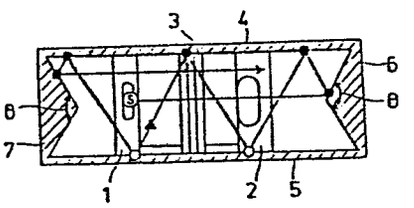

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Photoelectric Smoke Detector

The invention relates to a photoelectric smoke detector equipped with a light emitter which radiates light into a measuring space and a light receiver which detects scattered light caused by entry of smoke into the measuring space.

Dark chambers of conventional photoelectric smoke detectors have a complicated labyrinth construction or double covers to prevent the environmental light from entering the dark chamber but to facilitate entry of smoke into the same.

However, those detectors with the above-mentioned dark chamber construction, being large in size, are not suitable for use as detectors built in equipment such as electronic computers or installed in lavatories in aircrafts. They also have such a shortcoming that miniaturizing them by merely reducing the sizes of their dark chambers results in lowering the SN ratio.

The present invention provides a photoelectric smoke detector equipped with a light emitter which radiates light into a measuring space and a light receiver which detects scattered light caused by entry of smoke into the measuring space, and characterized in that a dark chamber which forms the above space at least comprises a front wall with a plane or curved surface which is arranged in front of the light emitter so that the light from the light emitter is reflected at a predetermined angle to the optical axis, and side walls which are arranged nearly in parallel with the optical axis.

According to a preferred embodiment of the invention the dark chamber comprises a rear wall with a plane or curved surface

which is arranged in the rear of the light emitter and reflects the reflected light from the side walls at such an angle that the reflected light does not directly irradiate the light receiver.

According to a further particularly preferred embodiment of the invention the photoelectric smoke detector is equipped with a dark chamber of the above composition whereby the above walls have mirror-like surfaces with good absorbance.

The photoelectric smoke detector according to the present invention is equipped with a dark chamber of the above composition whereby the dark chamber itself is capable of performing a light trap function. More specifically, the dark chamber is designed in such a way that the light beam radiated by the light emitter is reflected from the wall surfaces of the dark chamber several times without allowing the initially reflected light to reach the light receiving element of the light receiver, and that reflected light reaching the light receiving element if any is attenuated to a very weak one. Therefore, it is not necessary to specially provide a light trap means, thus a small-sized photoelectric smoke detector with a narrow measuring space is obtained.

The invention will now be described, by way of example, with reference to the accompanying drawings, in which are shown:

Figures 1 through 3 are schematic diagrams of the photoelectric smoke detectors according to the present invention. (a) cross section (b) transverse section. Figure 4 shows characteristics.

The following describes embodiments of the photoelectric smoke detector according to the present invention in reference to Figures 1 through 3. In these figures, (a) is a cross section and (b) is a transverse section of the dark chamber according to the present invention, wherein the components are indicated by numerals as follows: 1 - a light emitter which is equipped with a light source such as light emitting diode and a lens, and radiates a convergent light beam; 2 - a light receiver comprising a light receiving element such as solar cell and a lens; 3 - a light shielding plate provided between the light emitter 1 and the light receiver 2; 4, 5 - side walls arranged nearly in parallel with the optical axis of the light beam radiated from the light emitter 1; 6 - a front wall with a plane or curved surface which is arranged in front of the light emitter 1 to reflect the light at a predetermined angle to the optical axis; 7 - a rear wall with plane or curved surface which is arranged in the rear of the light emitter 1 to reflect the reflected light from side walls 4, 5 at a predetermined angle so that the reflected light does not directly irradiate the light receiving element of the light receiver 2; 8, 9 - a bottom wall and a top wall with apertures through which smoke can flow in (not shown on the drawing) and which are provided in the center of the bottom wall 8 and near both ends of the top wall 9. The wall surfaces are of black color and finished up like a mirror. Further in the figures, s - a starting point of the light beam; arrow - a point where the light beam reaches; black dots - reflection points on the side wall 4; white dots - reflection points on the side wall 5; triangle - a reflection point on the top wall 9.

According to a preferred embodiment of the invention the walls of the dark chamber have mirror-like surfaces with good absorbance. In this case, for example, the convergent light beam

radiated from the light emitter 1 impinges on the left side surface of the front wall 6 and is absorbed by the black surface. Unabsorbed light is reflected from the mirror-like surface nearly as it is, i.e. in the form of convergent light beam without being diffused, and from the left wall 4, the right and left walls 5, 4, further from the top wall 9, the right wall 5, the left wall 4, the left side of the rear wall 7, and then impinges on the outer wall of the light receiver 2. As can be seen from the above description, the dark chamber acts as light trap, where the light radiated from the light emitter 1 is absorbed by the black surfaces and attenuated while being reflected several times, and eventually becomes a very weak light.

Further describing the idea in reference to Fig. 2, the light radiated from the light emitter 1 is reflected from the left side of the front wall 6, the left wall 4, the right, left, right walls, the top wall 9, the left wall 4, the right wall 5, and the right side of the rear wall 7 and then impinges on the outer wall of the light receiver 2. In Fig. 3, the light radiated from the light emitter 1 is reflected from the left side of the front wall 6, the left wall 4, the top wall 9, the right, left, right, left walls and the left of the rear wall 7, and then impinges on the outer wall of the light emitter 1, thus being attenuated to a very weak light.

On the other hand, if a fire breaks out and smoke enters the dark chamber, scattered light irradiates the light receiving element of the light receiver 2, where an output to give a fire alarm develops. Fig. 4 shows characteristics of the dark chamber, with S representing output of the light receiving element when a predetermined density of smoke for decision on fire entered the dark chamber, N representing output of

the light receiving element in normal condition, and θ representing angles of the front and rear walls 6, 7. According to this Figure, a sufficient SN ratio for practical use is obtained at θ of not more than 140° and not less than 210°.

The photoelectric smoke detector according to the present invention is equipped with a dark chamber of the above composition whereby the dark chamber itself is capable of performing a light trap function. More specifically, the dark chamber is designed in such a way that the light beam radiated by the light emitter is reflected several times from the side walls via the front and rear walls, without allowing the initially reflected light to reach the light receiving element of the light receiver, and that reflected light reaching the light receiving element if any is attenuated to a very weak one. Therefore, this idea has such an effect that a small-sized photoelectric smoke detector which has a narrow measuring space and does not require special provision of a light trap means is obtained.

Claims

1. A photoelectric smoke detector equipped with a light emitter (1) which radiates light into a measuring space and a light receiver (2) which detects scattered light caused by entry of smoke into the measuring space, characterized in that a dark chamber which forms the measuring space at least comprises a front wall (6) with a plane or curved surface which is arranged in front of the light emitter (1) so that the light from the light emitter (1) is reflected at a predetermined angle to the optical axis, and side walls (4, 5) which are arranged nearly in parallel with the optical axis.

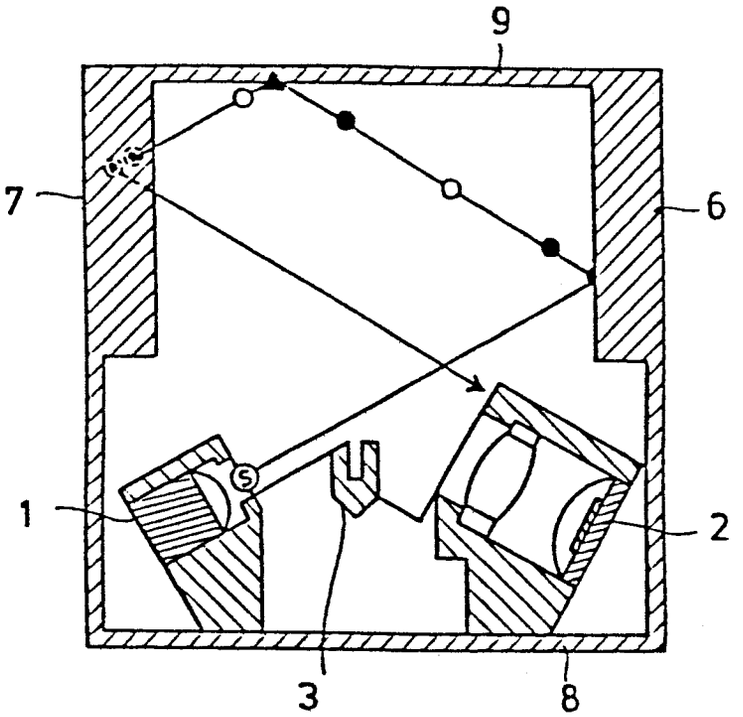
2. A photoelectric smoke detector as defined in claim 1, characterized in that the dark chamber which forms the measuring space is composed of said front wall (16) and a rear wall (7) with a plane or curved surface which is arranged in the rear of the light emitter (1) and reflects the reflected light from the side walls (4, 5) at such an angle that the reflected light does not directly irradiate the light receiver (2).

3. A photoelectric smoke detector is defined in claim 2, characterized in that the walls (4, 5, 6, 7, 8, 9) of the dark chamber which forms the measuring space have mirror-like surfaces with good absorbance.

1/4

Fig. 1

(a)



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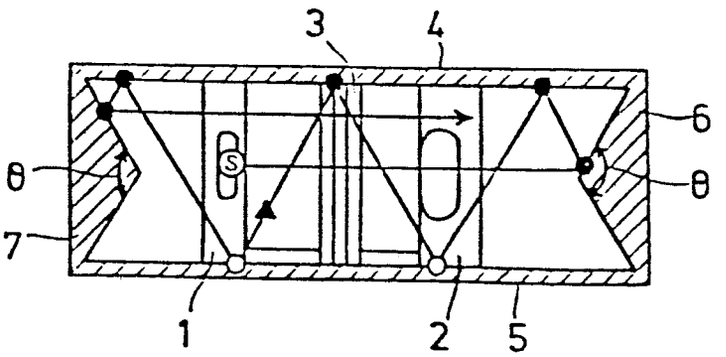
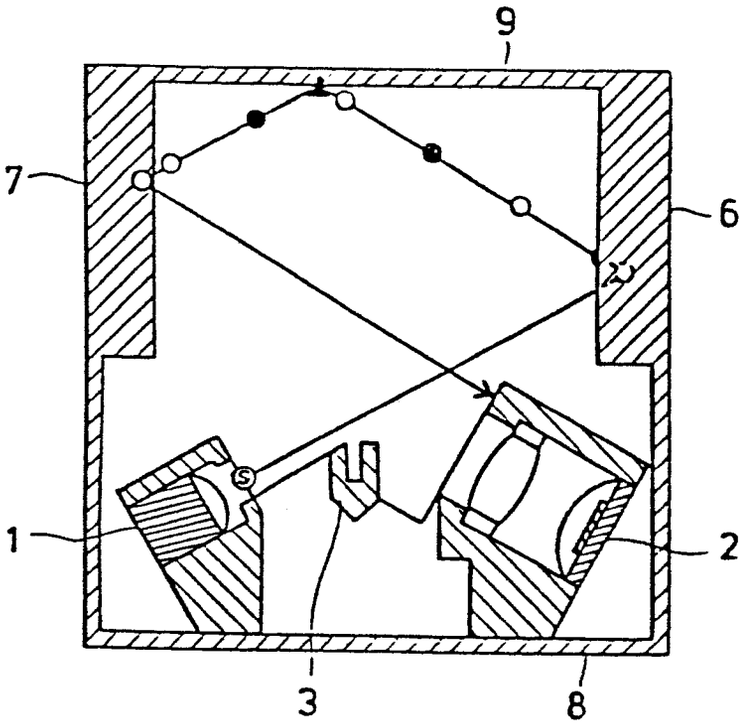


2/4

Fig. 2

(a)



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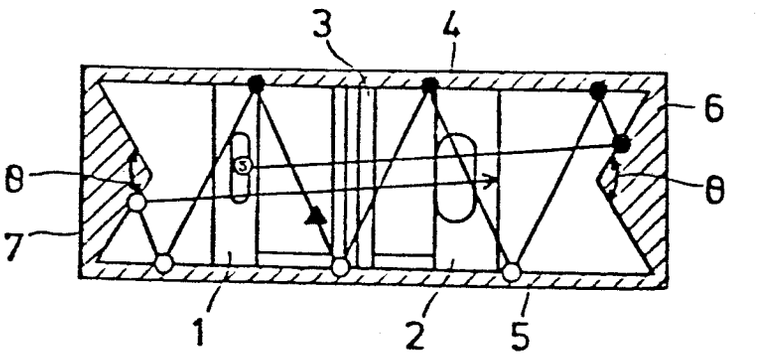
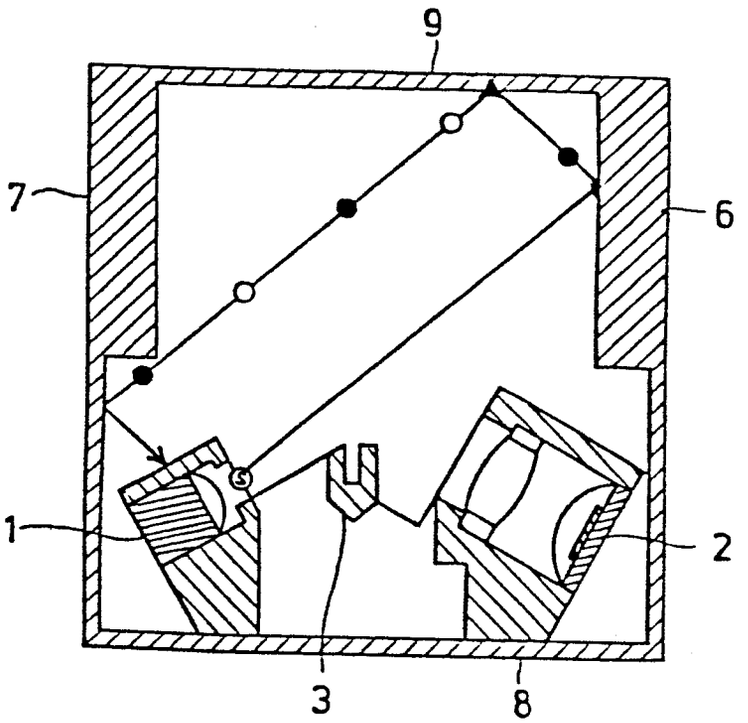


3/4

Fig. 3

(a)



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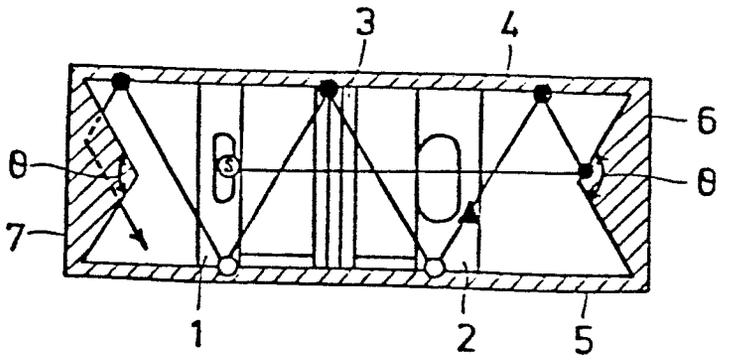
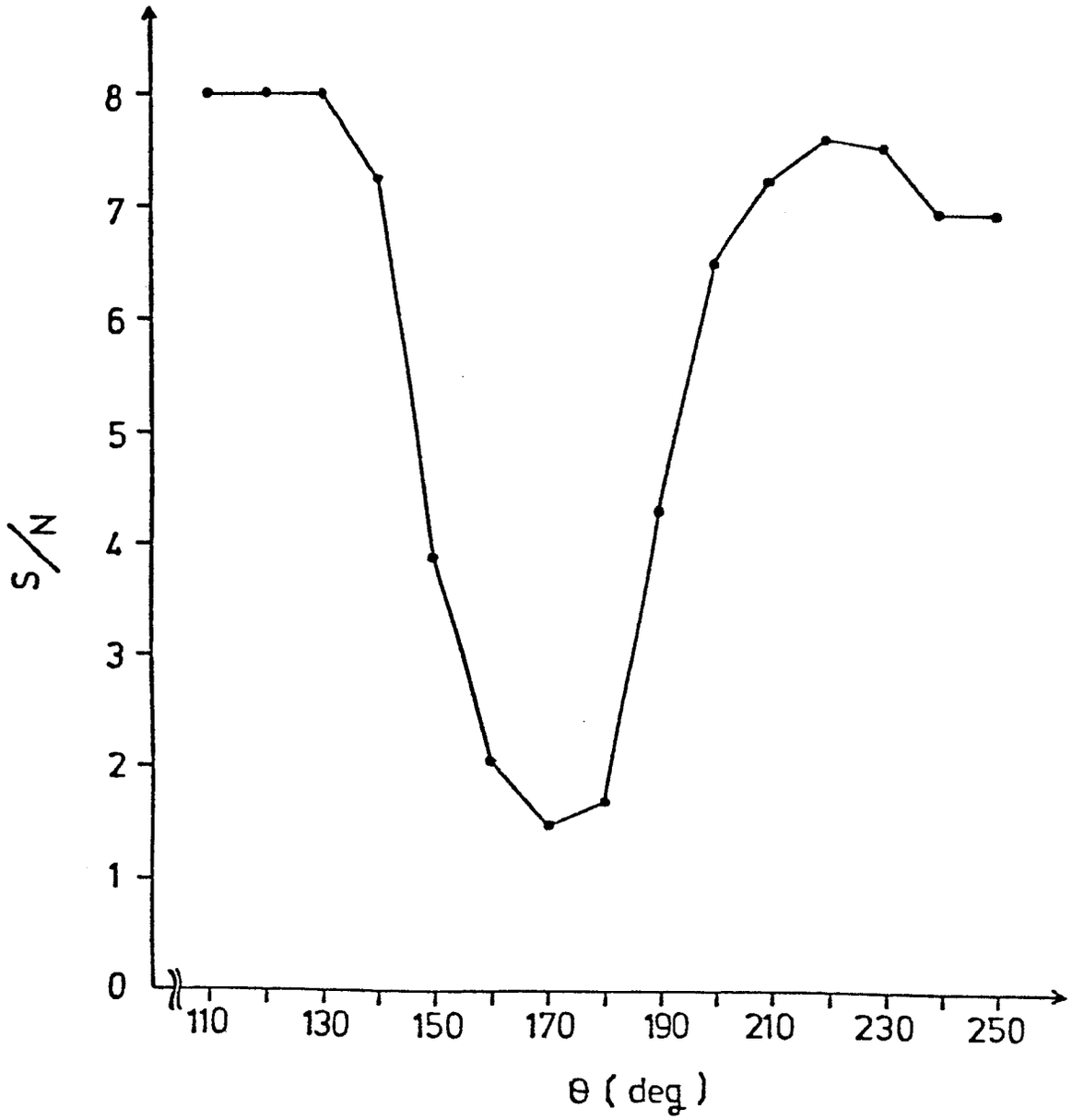


4/4

Fig. 4



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EUROPEAN SEARCH REPORT

0175940
Application number

EP 85 11 0642

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int. Cl.4)
Y	PATENT ABSTRACTS OF JAPAN, vol. 6, no. 112 (P-124)[990], 23rd June 1982; & JP - A - 57 42842 (NITSUTAN K.K.) 10-03-1982	1,2	G 08 B 17/10
Y	US-A-3 708 675 (K. TASHIRO et al.) * figure 10; column 7, lines 1-21, 36-65 *	1,2	
A	DE-U-1 798 135 (WALTHER & CIE.) * figure 4; page 4, lines 1-5, 13-18 *	1,3	
A	DE-A-2 758 517 (GENERAL ELECTRIC) * figure 1 *	1	
A	US-A-4 216 377 (MITSUO HASEGAWA et al.) * figures 1, 2, abstract *	1	TECHNICAL FIELDS SEARCHED (Int. Cl.4) G 08 B 17/10 G 01 N 21/53
A	DE-A-3 008 183 (SVENSKA UTVECKLINGSAKTIEBOLAGET) * figures 1, 2 *	1	
A	GB-A-1 129 402 (WALTER KIDDE) * figure 1 *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	04-12-1985	BREUSING J

CATEGORY OF CITED DOCUMENTS

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