(12) UK Patent Application (19) GB (11) 2 175 686 A

(43) Application published 3 Dec 1986

(21) Application No 8513419

(22) Date of filing 28 May 1985

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(51) INT CL[4]
G08B 17/12 29/00

(52) Domestic classification (Edition H):
G1A A9 D10 D4 D6 G14 G6 MZ P16 P5 P9 R6 S10 S13 S2 S5 S7 T15 T20 T3
U1S 1921 2191 2192 2195 2197 2322 G1A

(56) Documents cited
GB A 2141228 EP A1 0079645 EP A2 0078443

(58) Field of search
G1A
Selected US specifications from IPC sub-classes G01J G08B

(54) Fire or explosion detection arrangement

(57) A fire or explosion detection arrangement has a housing 5 with first (10) and second (22) adjacent radiation-transmitting windows. The window 10 includes a radiation transmitting filter 14 having a passband corresponding to a narrow predetermined wavelength band. A radiation sensor 6 mounted within the housing receives radiation from a fire or explosion external to the housing through the first window 10, the predetermined passband corresponding to a wavelength band within which a fire or explosion to be detected generates radiation. A source of testing radiation 24 is mounted externally of the housing 5 and generates testing radiation having a wavelength or wavelengths capable of passing through the second radiation transmitting window 22 but not through the filter 14. This testing radiation is directed to the radiation sensor 6. There, means (either the sensor 6 or, for example, an FET 20 which is provided to process the normal output of the sensor 6) responds to the level of the testing radiation received at the sensor and a circuit 18 determines from the level of the testing radiation received whether the level of obscuration of the second window 22 lies above or below a predetermined level. This is used to make an assessment whether the level of obscuration of the first window 10 lies above or below the predetermined level.

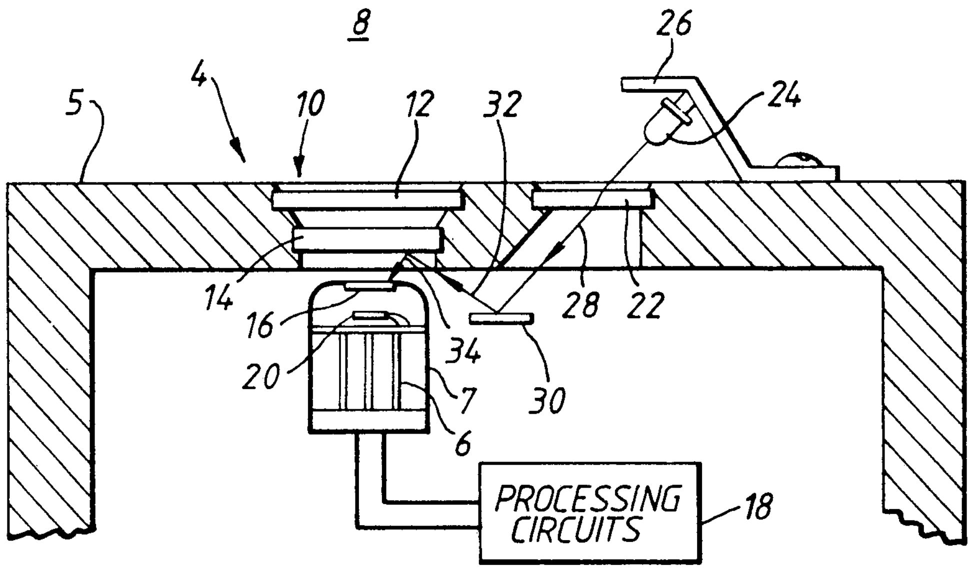

FIG.1.

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

The claims were filed later than the filing date within the period prescribed by Rule 25(1) of the Patents Rules 1982.

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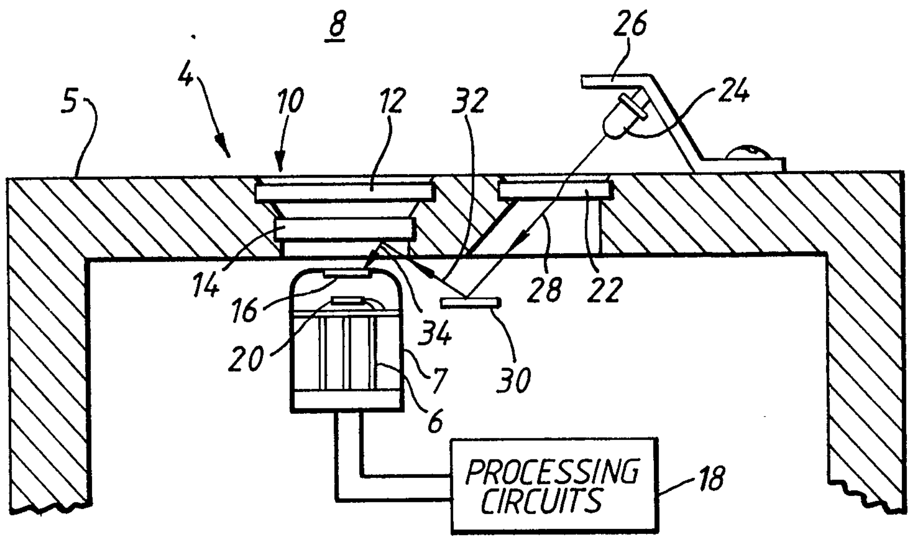

FIG.1.

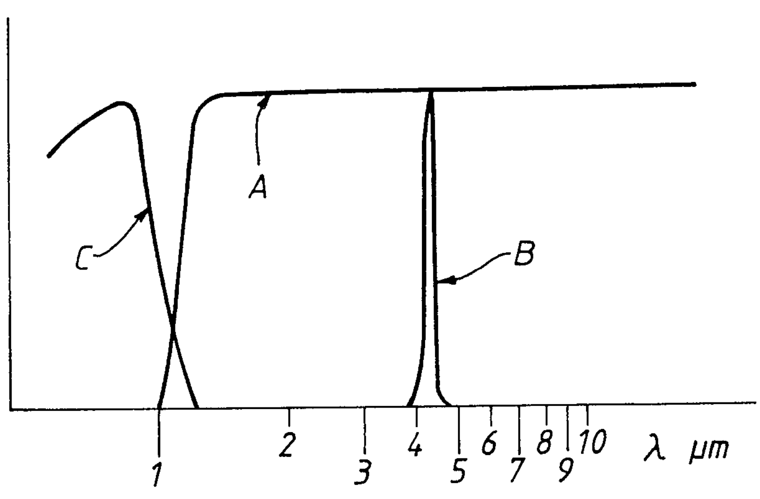

FIG.2.

SPECIFICATION

Improvements in and relating to radiation sensing arrangements

The invention relates to radiation detection systems and more particularly, though not exclusively, to such systems used for detecting fires or explosions by means of the radiation which they emit.

Radiation detection systems employ a suitable radiation detector which is normally mounted behind a "window" through which it views the area to be monitored, and this window may incorporate a radiation filter so as to render the radiation sensor responsive to radiation lying within a specific narrow band. In order for the system to be able to operate correctly, it is clearly necessary to ensure that the window is always sufficiently clean to enable the sensor to pick up the radiation to be detected. Some form of arrangement to enable the cleanliness of the window to be checked is therefore required.

According to the invention, there is provided a method of checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation passing through the said window, in which the window will only allow transmission of radiation from hot sources, comprising the step of directing testing radiation from a cold source towards an adjacent window capable of transmitting the testing radiation, and sensing the testing radiation transmitted through the adjacent window.

According to the invention, there is also provided a method of checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation within a predetermined wavelength band and passing through the said window, comprising the steps of generating testing radiation, directing the testing radiation through a second window adjacent to the first-mentioned window, and sensing for at least a predetermined level of received testing radiation by means of or immediately in the vicinity of the said radiation sensing means.

According to the invention, there is further provided apparatus for checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation passing through the said window, in which the window will only allow transmission of radiation from hot sources, comprising means for directing testing radiation from a cold source towards an adjacent window capable of transmitting the testing radiation, and sensing means for sensing the testing radiation transmitted through the adjacent window.

According to the invention, there is still further provided an obscuration checking system for checking obscuration of a window through which radiation sensing means is arranged to sense radiation lying within a predetermined wavelength band and originating in an area on the opposite side of the said window to the radiation sensing means, comprising a source of testing radiation, means defining a radiation path for the testing radiation which directs the testing radiation to the radiation sensing means, the said path including a second window physically adjacent to the first-mentioned window and arranged such that the source of testing radiation lies on the opposite side of the second window to the radiation sensing means, and means responsive to the level of the testing radiation received at the radiation sensing means to determine whether the level of obscuration of the second window lies above or below a predetermined limit.

According to the invention, there is further provided a fire or explosion detection arrangement, comprising a housing having first and second adjacent radiation-transmitting windows, the first radiation transmitting window including a radiation transmitting filter having a passband corresponding to a predetermined wavelength band, a radiation sensor mounted within the housing so as to receive radiation from a fire or explosion external to the housing through the first window, the predetermined passband corresponding to a wavelength band within which a fire or explosion to be detected generates radiation, a source of testing radiation mounted externally of the housing and energisable to generate testing radiation having a wavelength or wavelengths capable of passing through the second radiation transmitting window but not through the first window, means for directing the testing radiation passing through the second window to the radiation sensor, and means responsive to the level of the testing radiation received at the sensor for determining whether the level of obscuration of the second window lies above or below a predetermined level, whereby to make an assessment whether the level of obscuration of the first window lies above or below a predetermined level.

A fire detection system embodying the invention will now be described, by way of example only, with reference to the accompanying diagrammatic drawing in which:

Figure 1 is a diagrammatic cross-section through the system; and

Figure 2 shows the spectral responses of various parts of the system.

As shown in Figure 1, the system is in the form of a detector 4 comprising a housing 5 inside which is mounted an infra-red radiation sensor 6 in a can 7. In this example, the sensor 6 is a pyroelectric-type sensor for example. The sensor views an area 8 (the area within which a fire is to be detected) through a window assembly shown generally at 10. The window assembly 10 comprises a sapphire window 12 behind which is mounted a narrow band filter 14 designed to pass radiation within a predetermined narrow wavelength band. The window assembly 10 is completed by a silicon window 16 which in fact is built in to the can 7.

The filter 14 ensures that only radiation within the narrow band centred on 4.4. micrometers reaches the sensor 6. The narrow band centred on 4.4 micrometers is the narrow band in which burning hydrocarbons emit peak radiation, and this ensures that the sensor 6 is rendered highly sensitive to radiation emitted by a hydrocarbon fire and relatively insensitive to radiation emitted by other potentially interfering sources such as solar radiation. The radiation within the narrow band heats the sensor 6 and the resultant electrical signal is fed to a suitable processing circuit shown diagrammatically at 18 via an FET 20 which provides an electrical buffering and impedance matching device. Such an arrangement therefore provides a convenient detecting system for detecting hydrocarbon fires.

It will be appreciated, however, that the efficiency of the detecting system depends on the cleanliness of the window assembly 10. More specifically, dirt on the outside surface of the window 12 will reduce the efficiency of radiation detection until eventually the system becomes too insensitive to be useful. It is therefore necessary to test the cleanliness of the window assembly 10 periodically. However, it is not practicable to test the cleanliness of the window assembly by providing an external source of radiation and directing this through the window assembly 10 on to the sensor 6, and monitoring the response of the latter. This is because any such testing must clearly produce a sufficient amount of radiation within the narrow passband of the filter 14 and this requires the radiation source to be at a considerable temperature. This is generally unsatisfactory and is completely unacceptable in those cases where certain "intrinsically safe" requirements have to be satisfied. Thus, if the environment within the area 8 has to be maintained intrinsically safe, it is clearly impossible to test the cleanliness of the window assembly 10 in the manner just suggested.

Therefore, in order to carry out cleanliness testing, the detector incorporates a second window 22 in the form of a silicon window mounted in the housing 5 immediately adjacent to the window assembly 10. On the outside of the housing 5 is mounted a light emitting diode (LED) 24 behind a protective cover 26. The LED is so positioned that the radiation it emits, when it is suitably electrically energised, passes through the window 22 and passes along a path indicated at 28 to strike the surface of a mirror 30 which is mounted (by means not shown) within the housing 5. The reflected radiation then passes along a path 32 to strike the inner surface of the filter 14 which reflects it along a path 34 so that it passes through the silicon window 16 to the sensor 6 which, in a manner to be explained, is arranged to produce an appropriate electrical response which is fed to the circuitry 18 where its level is monitored. In this way, therefore, the radiation from the LED 24 does not have to pass through the filter 14 in order to reach the sensor 6. The protective cover 26 also acts to block any extraneous radiation which would otherwise follow the same path as the light from the LED 24.

The level of the output produced at the sensor 6 in response to the radiation reaching it from the LED 24 will clearly be dependent on the cleanliness of the window 22. However, because the radiation from the LED 24 passes through the window 22 but not through the window assembly 10, the arrangement will only be effective as a test of the cleanliness of the window assembly 10 if it can be assumed that the state of cleanliness of the window 22 is a sufficient measure of the state of cleanliness of the window assembly 10. Provided that the window 22 is sufficiently close to the window assembly 10, and in the absence of abnormal ambient conditions, it is found that this assumption is correct.

In order for the radiation from the LED 24 to be useful for checking the cleanliness of the window assembly 10, it is of course necessary for the LED to emit radiation at a wavelength and intensity sufficient to cause the sensor to produce a suitable response. The sensor 6 may itself directly produce the electrical output in response to the radiation from the LED 24. However, if the sensor 6 is not itself capable of producing a sufficient response to the radiation received from the LED 24, a supplementary sensor, suitably arranged to be sufficiently responsive to that radiation, may be provided and, for example, incorporated within the can 7. In fact, it is found that the FET 20 itself may be particularly sensitive to radiation between 1 and 1.5 micrometers and is capable of producing an adequately large electrical output to satisfy the requirements for the test.

Figure 2 shows at A the spectral transmission of the silicon windows 16 and 22. The spectral response of the filter 14 is shown at B. Finally, the spectral emission of the LED 24 is shown at C. It will be apparent that the radiation emitted by the LED 24 is incapable of being transmitted through the filter 14 and it thus follows that this radiation could not be used to test the cleanliness of the window assembly 10 by passing the radiation directly through the window assembly. However, the LED 24 does emit a reasonable amount of radiation at about 1.5 micrometers which is thus able to pass through the silicon windows 22 and 16.

An LED is a "cold" emitter of radiation, that is, when electrically energised so as to emit radiation its temperature does not rise significantly and certainly not above the limits laid down by intrinsically safe requirements. Furthermore, the necessary electrical energisation required for the LED also satisfies intrinsically safe requirements.

The processing circuitry 18 can be arranged to be switched into a checking mode as required. For example, the detector may be provided by an operator-controlled check switch. When this is operated, the LED 24 is energised and simultaneously switches the processing circuitry 18 into the checking mode in which it monitors the resultant output from the sensor 6 (or from the FET 20 or any other supplementary sensor provided). If the intensity of the radiation received from the LED 24 is sufficient to indicate adequate cleanliness of the window 22 (and thus of the window assembly 10 as well), an appropriate indication is given. Instead, however, the checking process may be initiated automatically at periodic intervals.

If the sensor 6 is itself arranged to respond to the testing radiation received from the LED 24, it will be apparent that the testing procedure not only checks the cleanliness of the window 22, and thus of the window assembly 10, but also checks the circuitry of the sensor 6 and its circuit connections. If the sensor 6 is not itself used to check the testing radiation from the LED 24, but an auxiliary sensor is used for this purpose (such as the FET 20), it is clearly advantageous for this to be positioned immediately adjacent to the sensor 6 so that it can be electrically connected to the output lines from the sensor 6 to the processing circuitry 18. In this way, again, the auxiliary sensor will not only check the cleanliness of the windows but also the circuit connections.

CLAIMS

1. A method of checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation passing through the said window, in which the window will only allow transmission of radiation from hot sources, comprising the step of directing testing radiation from a cold source towards an adjacent window capable of transmitting the testing radiation, and sensing the testing radiation transmitted through the adjacent window.

2. A method according to claim 1, in which the sensing step is carried out by means of an auxiliary sensor juxtaposed with the radiation sensing means.

3. A method of checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation within a predetermined wavelength band and passing through the said window, comprising the steps of generating testing radiation, directing the testing radiation through a second window adjacent to the first-mentioned window, and sensing for at least a predetermined level of received testing radiation by means of or immediately in the vicinity of the said radiation sensing means.

4. A method according to claim 3, in which the step of sensing for at least a predetermined level of received testing radiation is carried out by means of an auxiliary sensor juxtaposed with the radiation sensing means.

5. A method according to claim 4, in which the auxiliary sensor is a field effect transistor which is connected in circuit with the radiation sensing means and also used for processing an electrical output thereof which is generated by the sensing means in response to radiation passing through the first-mentioned window and lying within the predetermined wavelength band.

6. A method according to any one of claims 3 to 5, in which the testing radiation lies outside the predetermined wavelength band.

7. A method according to any one of claims 3 to 6, in which the testing radiation passes to the radiation sensing means or to the immediate vicinity thereof via a path including radiation reflecting means.

8. A method according to claim 7, in which the first-mentioned window includes a radiation filter having a passband corresponding to the said predetermined wavelength band, and in which the reflecting means comprises the filter means.

9. A method according to any preceding claim, including the step of generating the testing radiation from an intrinsically safe source.

10. Apparatus for checking for obscuration of a radiation-transmitting window in a radiation detection system incorporating radiation sensing means arranged to sense radiation passing through the said window, in which the window will only allow transmission of radiation from hot sources, comprising means for directing testing radiation from a cold source towards an adjacent window capable of transmitting the testing radiation, and sensing means for sensing the testing radiation transmitted through the adjacent window.

11. Apparatus according to claim 10, in which the sensing means comprises an auxiliary sensor juxtaposed with the radiation sensing means.

12. An obscuration checking system for checking obscuration of a window through which radiation sensing means is arranged to sense radiation lying within a predetermined wavelength band and originating in an area on the opposite side of the said window to the radiation sensing means, comprising a source of testing radiation, means defining a radiation

path for the testing radiation which directs the testing radiation to the radiation sensing means, the said path including a second window physically adjacent to the first-mentioned window and arranged such that the source of testing radiation lies on the opposite side of the second window to the radiation sensing means, and means responsive to the level of the testing radiation received at the radiation sensing means to determine whether the level of obscuration of the second window lies above or below a predetermined limit.

13. A system according to claim 12, in which the means responsive to the level of the testing radiation received at the radiation sensing means comprises the radiation sensing means itself.

14. A system according to claim 12, in which the means responsive to the level of the testing radiation received at the radiation sensing means comprises auxiliary radiation sensing means.

15. A system according to claim 14, in which the auxiliary radiation sensing means comprises an FET which is connected in circuit with the radiation sensing means for processing an electrical output produced thereby in response to radiation which it receives from the said area through the first-mentioned window.

16. A system according to any one of claims 12 to 15, in which the first-mentioned window includes a radiation filter having a passband corresponding to the said predetermined wavelength band.

17. A system according to claim 16, in which the testing radiation lies outside the passband of the said radiation filter.

18. A system according to any one of claims 10 to 17, in which the source of testing radiation is an intrinsically safe source.

19. A system according to any one of claims 10 to 18, in which the radiation sensing means is an infrared radiation sensor and the source of testing radiation is a light emitting diode.

20. A fire or explosion detection arrangement, comprising a housing having first and second adjacent radiation-transmitting windows, the first radiation transmitting window including a radiation transmitting filter having a passband corresponding to a predetermined wavelength band, a radiation sensor mounted within the housing so as to receive radiation from a fire or explosion external to the housing through the first window, the predetermined passband corresponding to a wavelength band within which a fire or explosion to be detected generates radiation, a source of testing radiation mounted externally of the housing and energisable to generate testing radiation having a wavelength or wavelengths capable of passing through the second radiation transmitting window but not through the first window, means for directing the testing radiation passing through the second window to the radiation sensor, and means responsive to the level of the testing radiation received at the sensor for determining whether the level of obscuration of the second window lies above or below a predetermined level, whereby to make an assessment whether the level of obscuration of the first window lies above or below a predetermined level.

21. A system according to claim 20, in which the radiation sensor itself is arranged to be responsive to the testing radiation.

22. A system according to claim 20, comprising an auxiliary sensor mounted immediately adjacent to the radiation sensor for sensing the testing radiation.

23. A system according to claim 22, in which the auxiliary sensor comprises an FET electrically connected to the radiation sensor so as to process an electrical output produced thereby in response to radiation received thereby through the first window within the predetermined wavelength band.

24. A system according to any one of claims 20 to 23, in which the means defining the path for the testing radiation includes radiation reflecting means.

25. A system according to claim 24, in which the reflecting means includes a surface of the radiation filter means.

26. A system according to any one of claims 20 to 25, in which the source of testing radiation is an intrinsically safe source.

27. A system according to any one of claims 20 to 26, in which the passband of the filter means comprises a narrow band including 4.4 micrometers.

28. A system according to any one of claims 20 to 27, in which the source of testing radiation comprises a light emitting diode emitting radiation between approximately 1 and 1.5 micrometers.

29. A method of checking obscuration of a radiation-transmitting window, substantially as described with reference to the accompanying drawings.

30. A fire detection system substantially as described with reference to the accompanying drawings.

Printed in the United Kingdom for
Her Majesty's Stationery Office, Dd 8818935, 1986, 4235.
Published at The Patent Office, 25 Southampton Buildings, London, WC2A 1AY, from which copies may be obtained.