

REPLACED SHEET		SG
☒	Description : page 1 to page 11	
☒	Table(s) : page 12 to page 14	
	Figure(s) : page 15 to page 16	
	Page 17 to page 18	

Device for testing the operation of smoke detectors

The invention concerns a device for testing the operation of smoke detectors according to the preamble of Claim 1. Such smoke detectors are generally known; they are used in fire alarm systems for the early detection of fires to detect smoke particles or aerosols appearing during a fire, and if necessary to send a signal to a central process unit, in which the signals are evaluated.

Examples of smoke detectors for the early detection of fires are ionisation smoke detectors in which the change in conductivity of ionised air is utilized to indicate fire aerosols, or optical smoke detectors in which the absorption or scattering of light by smoke particles is used. Since in ionisation smoke detectors radio activity - albeit low-level - is present, optical smoke detectors are increasingly used, especially scattered-light detectors, since the latter can be of punctiform construction. i.e. have a small space requirement.

Optical smoke detectors operating on the scattered-light principle contain a radiation source and a radiation detector arranged outside the direct radiation area of the radiation source, that in the presence of smoke or fire aerosol in the radiation area (measuring chamber) is exposed to scattered radiation and generates electrical output signals depending on the strength of the scattered radiation, which are evaluated in an electronic circuit present in the smoke detector for alarm generation, or passed to the central process unit. In order to avoid interference by outside light, the light sources frequently operate in a pulsed manner, for example see the smoke detector system described in EP-B1-0'079'010.

Fire alarm systems must be ready for operation over long time periods. The smoke detectors are exposed to the harmful effects of the surrounding atmosphere, e.g. dust or corrosive vapours; furthermore, the quality of the electronic components, especially the radiation source and the radiation

This Sheet Has Been Replaced



detector can be reduced by ageing. It is therefore necessary to check the operational capability of the smoke detectors at regular intervals.

In practice, this test is usually effected by igniting a small test fire underneath the smoke detector, which produces smoke which can enter the detector and make it respond. The test has also be carried out by placing a burning wick, e.g. on a rod, directly under the detector (for example see US-PS-4,271,693). Apart from the fact that these methods are rather cumbersome, they frequently result in contamination of the detector, which could render it incapable of operation.

An attempt has therefore been made to replace the smoke by droplets of fluid, e.g. artificially-produced mist, since such aerosols affect the smoke detectors in the same way as smoke from fires. For example, a mist of water droplets has been produced and used for the test. The layer of water deposited on the inner surfaces makes the detector inoperative over long periods.

Test agents which have proved most successful are mixtures of halogenated hydrocarbons (propellants) which have a suitable boiling point and which are blown directly into the smoke detectors from suitable storage containers arranged in so-called detector testers (for example see DE-B2-20'54'027). Due to the pressure-loss during discharge a suitable quantity of aerosol is produced for testing the smoke detector. Due to the high vapour pressure of the halogenated hydrocarbons, the propellant evaporates within a short time and the operational capability of the detector is not impaired.

A suitable detector tester for the testing of smoke detectors with halogenated hydrocarbons consists of a housing open at one end, which can be placed over the smoke detector, whose volume is at least twice the volume of the smoke detector, and a container connected to the housing that contains the



propellant liquified under pressure and which, with the housing in place, has a spray valve operated manually or automatically, whose nozzle leads into the inside of the housing.

Because of the environmentally-harmful properties of halogenated hydrocarbons, these can no longer be used. Materials considered as replacements are mostly inflammable, toxic, corrosive and/or expensive (see Nachr. Chem. Tech. Lab. 40 [1992], No. 12, page 1398).

Other test methods for fire alarm systems with optical smoke detectors are known, which operate without the use of test gases. Generally speaking, procedures are also used in this case, which simulate the ingress of smoke into the smoke detectors. Here for example, an additional light source which projects light directly onto the radiation detector can simulate the appearance of scattered light in the smoke detector (US-PS-2,627,064).

A test device is described in US-OS-3,585,621, in which a calibration element which projects scattered light onto the light detector and, for example, simulates a smoke concentration of 4%, is used to check the light source. In GB-PS-1,079,929 testing of the optical smoke detector is implemented by simulating an alarm (scattered light) by introducing a vane into the radiation path.

The voltage at the input of the threshold detector can also be increased to a value just under the response voltage by means of a switch (JP-PA-46-12199); the peaks of the diffused stray light, which are normally well below the response threshold, are in this case increased until an alarm is generated during the test; here it is possible to test the operation of flash lamp, photocell, amplifier and switching circuit simultaneously.

This Sheet Has Been Replaced



A photo-electric smoke detector for indicating both alarm and fault conditions is disclosed in US-A-4,306,230, which has a detection device consisting of a light source and a light-sensitive element arranged outside the direct path of the light source, which generates an output signal in relation to an initial change caused by the presence of smoke. In the smoke detector a second detection device is provided, which makes it possible to detect a fault condition (contamination of the surfaces of the light source or light-sensitive element) by allowing a predetermined amount of light to fall through an opening in the housing of the detector onto the light-sensitive element. If the amount of light falling through the opening does not trigger a signal within a specific range, then a detector fault is indicated.

A method for testing photo-electric smoke detectors is described in EP-A1-0'122'5489, in which, in addition to the smoke-indicating light source and the smoke-indicating light detector, a test light detector which receives light directly from the light source, and a test light source which radiates light directly onto the smoke-indicating light detector in relation to the output signal of the test light detector, are provided in the measuring chamber of the scattered-light smoke detector. In this method the operation of the smoke detector is continuously monitored by a control centre; the detector is tested to ascertain if it is operating correctly and if its sensitivity is within the normal range.

The disadvantage of all these test methods is that means for testing the detector have to be provided in each individual smoke detector, which makes the fire alarm system considerably more expensive.

A device for testing the operation of optical smoke detectors is described in JP-PA-53-99899, in which a part of the housing that shields the measuring chamber against the external atmosphere, is comprised of rubber or an elastic body, e.g. a



sponge. The elastic body is covered by a flat plate which has an opening in the centre. For testing, a device consisting of four arms that are placed over the detector, is used; in the centre of the four arms is a needle that passes through the rubber into the measuring chamber of the detector and simulates the appearance of scattered light in the chamber. This means that constructive means must be provided on or in the detectors, which facilitate the function test.

Based on this state-of-the-art, the aim of the invention is to create a device for testing the operation of smoke detectors which avoids the disadvantages of known devices for testing the operation of smoke detectors and which makes it especially possible to test the detectors at the installation site without having to use means which can damage the detectors or the environment. A further aim of the invention is to be able to test the detectors without having to install constructive means on or in the individual detectors.

In a device for testing the operation of smoke detectors of the type stated above, these aims are achieved by the characterising features of Claim 1. A method for testing the operation of scattered-light smoke detectors is claimed in Claim 10 and preferred embodiments of the invention and forms thereof are defined in the dependent claims.

The method according to the invention for testing the operation of smoke detectors, particularly scattered-light smoke detectors, is based on the fact that a scattered-light smoke detector is shielded to a great extent from light from the environment entering the detector, and that the shielding, however, is not absolute since the detectors must be open to the outside atmosphere to enable smoke to enter the measuring chamber. Due to scattering of the light at components inside the detector, light from the light source of the detector can pass through to the outside and conversely, light from outside



can be radiated to the inside of the detector and reach the light detector by scattering.

According to a preferred embodiment of the device according to the invention, the housing also has a test light detector that can receive the light that comes from the inside of the smoke detectors by scattering. The output signal of this test light detector controls the test light source so that this radiates a light pulse to the inside of the smoke detector under test, which corresponds to the light pulse radiated from the smoke-indicating light source of the smoke detector.

In accordance with a further preferred embodiment of the device according to the invention, at its upper edge the housing has means distributed over the periphery, that are constructed so that when the detector tester is placed over a smoke detector under test, they ensure that the detector tester always has the same alignment with respect to the smoke-indicating light detector of the smoke detector. This ensures that the same test conditions apply during the testing of different smoke detectors. Preferably, the means for aligning the detector tester consist of projections and guide slots, the latter making contact with a guide lug provided on the smoke detector. This guide lug does not need to be additionally provided for testing purposes since it must be present anyway for the correct insertion of the detector into the base (electrical contacts; alignment of the alarm indicator).

For better handling of the detector tester, at the closed end of the housing is an extension which can be axially plugged onto an extensible rod, that is preferably hollow, to be able to test smoke detectors that are fitted to ceilings in tall rooms.

In accordance with a form of the device according to the invention, additional means can be provided in or on the



housing for testing ionisation smoke detectors, via which an air-stream can be blown into an ionisation smoke detector under test. Further means, with which the air-stream can be optionally heated, are provided in order that thermal detectors can also be tested with this preferred embodiment of the device according to the invention.

In another form of the device according to the invention, means are provided in the evaluation electronics, which enable the smoke-indicating light source in the smoke detector to be tested for ageing, contamination or defect by means of a quantitative or threshold measurement of the light output which falls onto the test light detector.

In accordance with a further preferred form of the device according to the invention, means for testing the operation are provided in the device, which prevent light emitted from the test light source and which falls onto the test light detector, from re-triggering a light pulse from the test light source. It is possible, for example, to block the electrical signal of the test light detector until a further light pulse leaves the smoke-indicating light source.

The invention is explained in more detail below with the aid of the embodiments illustrated in the drawings, of which:

Figure 1 shows a longitudinal section through a device for testing the operation of smoke detectors according to this invention and

Figure 2 shows a cross-section through a device for testing the operation of smoke detectors, along the line A...B in Figure 1.

Where the drawings are described below, it is understood that the representation has been simplified to the extent that only so much of the construction of the test device for a photo-electric smoke detector is shown that is necessary for the

This Sheet Has Been Replaced



expert to easily understand the underlying principles and terms. Throughout this description and in the claims, only "light", "light" sources and "light"-sensitive elements ("light" detectors) are discussed. However, it is clear that the term "light" is also understood to mean invisible light such as infra-red radiation or ultraviolet light, i.e. basically any electromagnetic radiation that is usually employed in optical smoke detectors. With reference to the figures, devices according to the invention are described in the form of examples and not limitations.

Figure 1 shows an embodiment of a device (detector tester) 7 according to the invention for testing the operation of smoke detectors. The detector tester 7 is shown in an axial longitudinal section; it is shown in the operating position when placed over a smoke detector 3, shown in side view, installed in the ceiling 6 of a room. The detector tester 7 consists of a rotationally-symmetric, cylindrical housing 1 that has a spigot-shaped extension 2 underneath, onto which a rod can be plugged to enable detectors 3, that are fitted in ceilings 6 of high rooms, to be tested.

A test light source 5 is mounted at the inner wall of the housing 1. At the upper edge of the housing 1 are several projections 8 distributed around the periphery of the edge, in which guide slots 9 are also provided, which, when the detector tester 7 is placed over a smoke detector 3 under test, in conjunction with a guide lug 11 placed on the smoke detector 3, ensure that the test light source 5 in the detector tester 7 is always in the same position relative to the smoke-indicating light detector 14 of the smoke detector 3, so that the same conditions always apply during the testing of different smoke detectors 3.

The housing 1 can be manufactured from any material; usefully, for weight-saving reasons, it is made from a suitable plastic or light metal. The electronics 12 of the detector tester 7,



e.g. the necessary batteries and such like for operating the test light source 5, are located in a separate compartment on the underside of the housing 1. The underside of the housing 1 and the electronics compartment 12 have an opening 23 through which the alarm indicator 22 of the smoke detector 3 can be observed.

To test a smoke detector 3, the detector tester 7 is placed over the smoke detector 3 so that the guide slots 9 slide over the guide lugs 11 on the smoke detector 3 and the projections 8 of the detector tester 7 make contact with the housing 1 of the smoke detector 3. By putting the test light source 5 into operation, a pulsed light beam is transmitted to the inside of the detector 3 and by observing the alarm indicator 22 on the smoke detector 3 or in the signal control centre (not shown) it can be ascertained whether the smoke detector 3 is operative.

In accordance with a preferred embodiment of a detector tester 7 according to the invention, Figure 1 shows a test light detector 4 (shown dotted in Figure 1) mounted on the inner wall of the housing 1. Otherwise this embodiment corresponds to the detector tester 7 as described above.

A horizontal section through this preferred embodiment of the detector tester 7, along the line A...B in Figure 1, is shown in Figure 2. As in Figure 1, it is shown in the operating position when placed over a smoke detector 3 mounted on the ceiling 6 of a room. Inside the smoke detector 3 are shown only the smoke-indicating light source 15, the smoke-indicating light detector 14 and means that, in this diagram are indicated by light shield plates 24, which prevent light falling directly from the smoke-indicating light source 15 onto the smoke-indicating light detector 14 of the smoke detector 3. Apart from the test light source 5, a test light detector 4 (shown dotted in Figure 1) is mounted on the inner wall of the housing 1.



Externally, the housing 1 is located with the three projections 8 and the guide slots 9, which are used in conjunction with the guide lug 11 on the smoke detector 3 to align the detector tester 7 with respect to the smoke detector 3. The result of this is that, when placed over a smoke detector 3 under test, the test light source 5 of the detector tester 7 and the smoke-indicating light detector 14, and the test light detector 4 and the smoke-indicating light source 15 of the smoke detector 3 are always in the same position with respect to each other, so that identical test conditions always apply during the testing of different smoke detectors 3.

The electronics 12 include an amplifier/bandpass filter (not shown) for amplifying, filtering and evaluating the electrical signal output by the test light detector 4, as well as electronic means for driving the test light source 5.

During the test process, due to scattering at components of the scatter-light smoke detector 3, the pulsed light of the smoke-indicating light source 15 passes out of the detector and falls on the test light detector 4 of the detector tester 7. Depending on the incident light, the test light detector 4 outputs an electrical signal that is amplified in the amplifier/bandpass filter. The electronics 12 contains means for comparing the amplitude of this signal with a predetermined threshold value. If the output signal of the amplifier exceeds this threshold value, the test light source 5 is triggered and outputs a light pulse that time-wise, partially overlaps those of the smoke-indicating light source 15 of the scatter-light smoke detector 3. Due to scattering at components of the smoke detector 3, this light pulse reaches the inside of the detector and falls onto the smoke-indicating light detector 14. After receiving such a pulse once or several times, an alarm signal is triggered in the smoke detector 3. The operational capability of the scattered-light



smoke detector 3 can thus be recognised at the alarm indicator 22 (or in the signal control centre).

Furthermore, the electronics 12 contains switching elements which prevent light from the test light source 5, that falls onto the test light detector 4, from causing re-triggering of the test light source 5. This can be achieved, for example, by blocking the output signal of the test light detector 4 for a time interval following the first triggering of the test light source 5, that is shorter than the time interval between two light pulses of the smoke-indicating light source 15 of the smoke detector 3.

In accordance with a further form of the detector tester 7 according to the invention, means can be provided in the housing 1, which make it possible to remove a smoke detector 3 from its holder and replace it. This dispenses with the use of a special device (detector extractor) for removing and fitting detectors.

In order to be able to test other smoke detectors that are not based on the scattered light principle, a fan can be mounted in the hollow extension 2 of the detector tester 7, which blows an air-stream into the housing 1 that is sufficiently strong to set an ionisation smoke detector into the alarm state. If a heating coil is placed in front of the blower, then the detector tester 7 can also be used for testing thermal detectors.

Within the scope of the invention, variations of the device for testing the operation of smoke detectors as described above are possible according to the claims and are familiar to the expert.

This Sheet Has Been Replaced



Claims

1. Device for testing the operation of smoke detectors, comprising a housing (1) open at one end, which can be placed over the smoke detector (3), in which means are provided, with which the occurrence of fire parameters is simulated inside the smoke detector (3), characterised in that a test light source (5) is arranged inside the housing (1) so that light transmitted from it can be received by the smoke-indicating light detector (14) of the smoke detector (3).
2. Device according to Claim 1, characterised in that furthermore, a test light detector (4) is arranged in the housing (1) so that it can receive light transmitted by the smoke-indicating light source (15) of the smoke detector (3).
3. Device according to one of the Claims 1 or 2, characterised in that in the housing (1), at its upper edge, means (8, 9) are provided and distributed over its periphery, that are constructed so that when placed over a smoke detector (3) under test, in conjunction with guide means (11) provided on the smoke detector (3), they align the detector tester (7) so that the test light source (5) of the detector tester (7) and the smoke-indicating light detector (14), and the test light detector (4) and the smoke-indicating light source (15) of the smoke detector (3) are always in the same position with respect to each other so that identical test conditions always apply during the testing of the smoke detector (3).
4. Device according to one of the Claims 1 to 3, characterised in that the means (8, 9) installed in the housing (1) consist of projections (8) and guide slots

This Sheet Has Been Replaced



(9), the latter making contact with a guide lug (11) provided on the smoke detector (3).

5. Device according to one of the Claims 1 to 4, characterised in that at the closed end of the housing (1) an axial extension (2) is formed, onto which a rod can be plugged.
6. Device according to one of the Claims 1 to 4, characterised in that means (12) are provided that prevent light that is emitted by the test light source (5) from re-triggering a light pulse.
7. Device according to Claim 6, characterised in that the means (12) that prevent light that is emitted by the test light source (5) from re-triggering a light pulse consist of switching elements that block the signal coming from the test light detector (4) for a sufficiently long time period.
8. Device according to one of the Claims 1 to 7, characterised in that means are provided in or on the housing (1) by which an air-stream can be blown into an ionisation smoke detector under test.
9. Device according to Claim 8, characterised in that means are provided by which the air-stream can be heated.
10. Method for testing the operation of optical smoke detectors, characterised in that light coming from the smoke-indicating light source (15) of a smoke detector (3) is received in a test light detector (4) and that by means of a test light source (5) a light signal corresponding or proportional to the light signal received by the test light detector (4) is radiated into the smoke detector (3) under test, and that a test is



This Sheet Has Been Replaced



made to ascertain whether the incident light signal sets the smoke detector (3) into an alarm state.



This Sheet Has Been Replaced

