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[54] **APPARATUS FOR CHECKING OPERATION OF SMOKE DETECTORS**

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[51] **Int. Cl.**.....**G08b 13/18**, G08b 27/00

[58] **Field of Search**..73/1 R; 252/359 A; 222/402.13

[56] **References Cited**

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[57] **ABSTRACT**

A testing device for smoke detectors wherein a housing is placed over the detector under test and a test medium is sprayed into the housing. The smoke detector responds to the test medium to indicate operability thereof. The internal volume of the housing is equal to at least twice the internal volume of the smoke detector under test.

13 Claims, 3 Drawing Figures

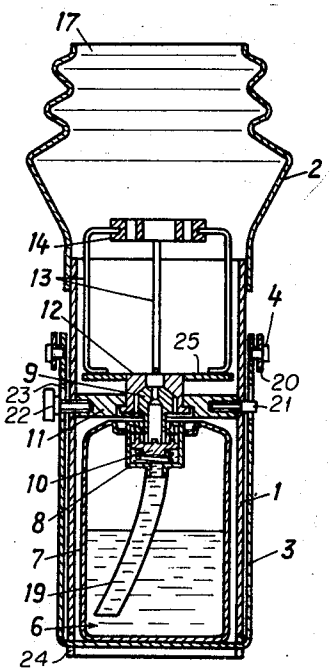


Fig. 1

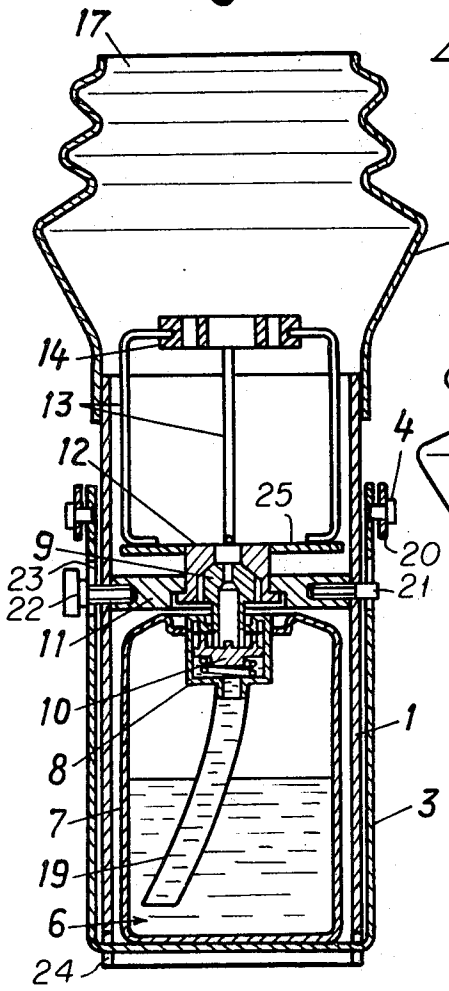
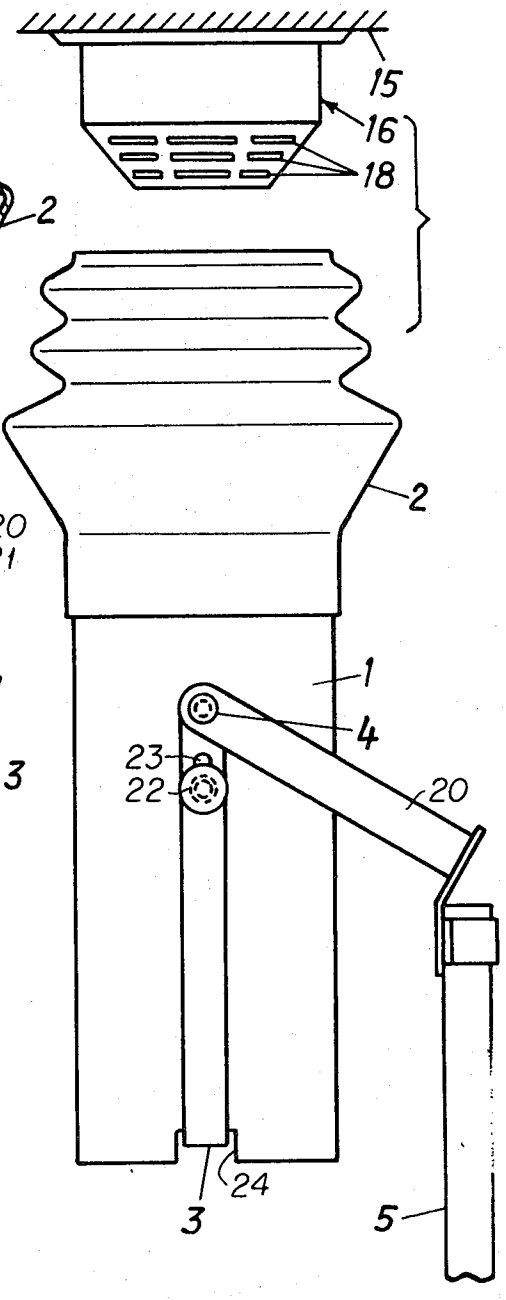


Fig. 2



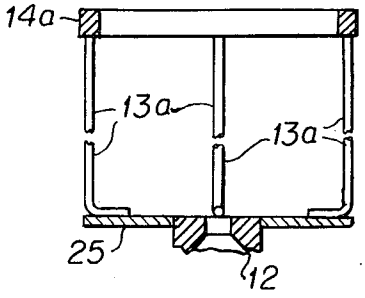


Fig. 3

APPARATUS FOR CHECKING OPERATION OF SMOKE DETECTORS

This invention relates to apparatus for checking the correct operation of smoke detectors.

Smoke detectors are employed to respond to smoke particles or aerosols resulting from combustion and to initiate an alarm signal in the event of their presence in the atmosphere. Smoke detectors usually contain at least one measuring chamber in which the characteristics of the air situated therein can be measured or observed. Examples of such smoke detectors are ionization fire alarms, in which the alteration of the conductivity of the air in the measuring chamber under the influence of radioactive radiation is observed, and optical smoke detectors, in which the absorption or scattering of light in the measuring chamber by smoke particles or aerosols is made use of. The invention is, however, not limited to testing smoke detectors of the kinds mentioned above, but may be employed for testing smoke detectors of other kinds.

Since smoke detectors are often in an operating condition for very long periods of time without a cause of alarm appearing to put the alarm into operation, it is necessary to check their operating state from time to time. In practice this is usually effected by generating smoke beneath the detector by a small test fire, so that the smoke can enter the detector and cause it to respond. Since this method is extraordinarily inconvenient, various other methods have been examined. In particular it has been sought to replace smoke by drops of fluid, i.e., clouds or aerosols, which affect the smoke detector in a manner equivalent to the presence of smoke in the atmosphere.

It has, for example, been attempted to generate a cloud of water droplets and to employ this cloud for testing smoke detectors. This has the disadvantage that a layer of moisture forms on the internal surfaces of the alarm device, which disappears only after some hours. In the meantime the alarm device is inoperative. In addition this method of testing is uneconomical.

Similar difficulties arise with the use of clouds of inorganic substances, such as may be generated by hydrolysis in damp air. For example, the reaction of $TiCl_4$ with water vapor forms a smoke of TiO_2, as well as hydrochloric acid vapor. Apart from the toxic effect, there thus results a considerable risk of corrosion. Since the smoke precipitates in the interior of the alarm device, the device must also be cleaned after each test. Known smoke candles have similar actions.

It has also been attempted to use various kinds of sprays generated in known manner for testing smoke detectors. A known manner of generating such a spray is by releasing through a suitable valve a carrier gas held under pressure in a container with an added solid or poorly volatile substance. After evaporation of the carrier means there remains behind a long-persistent cloud of the added substance. Such a spray is unsuitable for the testing of smoke detectors, since once again there are formed in the measuring chamber deposits of the added substance, which may remain for days or weeks and make the detector device inoperable. Cleaning of the alarm device after each test is therefore necessary.

It has heretofore been attempted to employ gases of high molecular weight, such as are used for example as

carrier gases for aerosol sprays, without added substances. Such gases usually have a boiling point below −20° C and are in a gaseous condition during the test. A disadvantage is that such a method of testing is suitable only for smoke detectors which respond to a change in the molecular weight of the gas within the measuring chamber, that is, ionization fire alarms, but is unsuitable for optical fire alarms.

In addition the testing gas must be present at a very high concentration. Since it disperses very rapidly over the whole ambient space, large amounts of the test substance are necessary. This method also cannot be regarded as practicable.

SUMMARY OF THE INVENTION

According to the present invention there is provided a device for testing the operation of smoke detector devices, comprising a housing member adapted to be placed over a smoke detector device, and having an internal volume equal to at least twice the internal volume of the detector device, a container containing a non-poisonous carrier medium liquified under pressure and having a boiling point in the range of −20° C to +20° C, and provided with a spray valve of which the nozzle leads into the interior of the housing and which is arranged when actuated to deliver said liquid medium as a spray into the housing.

The invention, therefore, provides a device which permits the operation of a smoke detector to be treated by generating a test aerosol. The test aerosol persists for an appropriate time, does not soil the smoke detector and does not have toxic characteristics. The housing of the testing device effectively forms a "sealed" chamber around the smoke detector under test. The device is so arranged that only a small quantity of the test substance is necessary for one test so that after the test the smoke detector immediately returns to an operational condition. Embodiments of the testing device are suitable for all known types of smoke detectors.

Particularly suitable carrier mediums are fully halogenated hydrocarbons with suitable boiling points. Mixtures of such halogenated hydrocarbons, in which one component has a boiling point below −20° C, while the other component has a boiling point between 0° and +10° C are particularly advantageous.

The spray valve is preferably a known spray valve which has as its aperture a nozzle which is small and is so formed that, together with appropriate construction of the carrier medium container, an appropriate emission and dispersion of the carrier medium is ensured.

An embodiment of the invention will now be further described with reference to the accompanying drawing, in which:

FIG. 1 is an axial section through a device in accordance with the invention;

FIG. 2 is a side elevation of the device of FIG. 1, showing its application to testing a smoke detector; and

FIG. 3 shows a modification of the device of FIGS. 1 and 2.

The device shown in FIGS. 1 and 2 comprises a cylindrical tube 1 to which there is secured at one end a sleeve member 2 made of a deformable material, for example rubber or soft plastic material. Member 2 is suitably formed as a bellows and is provided at its upper

end 17 with an opening so that it may be placed over the fire alarm device to be tested.

Within the tube 1 is positioned a spray canister 6, filled with a suitable substance, which canister is prevented from falling out by means of a stirrup 3 extending across the lower end of tube 1. Stirrup 3 is pivoted by means of rivets or screws 4 to the arms of a forked member 20 secured to the top of a supporting rod 5 (see FIG. 2). Stirrup 3 is secured to tube 1 by a peg 21 and a screw 22 with a knurled head, which pass through slots 23 in the limbs of the stirrup. In the normal position of stirrup 3 its foot portion engages in notches 24 formed in the lower end portion of tube 1 and the stirrup is held to the tube by tightening screw 22. To remove the spray canister 6, screw 22 is loosened, the stirrup 3 is drawn downwards from notches 24 and then pivoted about screw 22 and pin 21 to leave the bottom of tube 1 unobstructed to allow canister 6 to be withdrawn from the tube 1 for replacement.

Spray canister 6 comprises a container 7 containing a liquid and a spray valve 8. Valve 8 is constructed in a known manner so that pressure on a valve knob or head 9, which is provided with a fine nozzle, produces an emission of liquid from the container 7. In the present case, pressure on the valve knob 9 produces a connection between a riser tube 19 within the container 7 and the exit nozzle in the valve knob 9. The presence of risertube 19 ensures that the fluid contents of the container 7 emerge through the valve 8, and not the carrier gas lying above the fluid in the container. When pressure on the valve knob 9 is released, then a suitable device, such as a spring-loaded plunger 10 again closes the valve 8. It should be noted that almost any valves for the generation of aerosols which are opened by pressure on a knob can be used. A particularly advantageous type of valve is a dosing valve which, in response to a single application of pressure on the release knob 9, allows only a predetermined quantity of carrier material to emerge from the container and is then automatically closed.

Within the tube 1 is arranged an annular plate 11, within the aperture of which is mounted a specially shaped annular member 12. The form of member 12 is such that on the one hand it engages the valve knob 9, the nozzle of which is directed towards the upper part of the tube 1, and on the other hand it can be displaced relative to annular member 11 without excessive play. An actuating structure comprises rods 13 coupling a perforated plate 14 to a plate 25 which is connected to annular member 12.

The mode of operation of the devise is as follows: The testing device, carried on mounting rod 5, is applied to the smoke detector 16 (FIG. 2) to be tested so that the circumference of the bellows-like sleeve 2 engages the surface 15 to which the smoke detector 16 is mounted. The smoke detector 16 is then situated within the upper part 17 of the sleeve 2. The testing device is then urged upwardly by means of rod 5, thus deforming sleeve 2, until the lower surface of the smoke detector 16 strikes against the perforated plate 14. The testing device is urged further upward. The resultant pressure on the plate 14 causes the member 12 and thus the valve knob 9 also to be pressed downwards relative to the tube 1 and canister 6, thereby opening the valve 8. In that portion of the upper part 17 of the sleeve 2, which is not occupied by the smoke detector 16 there is then formed a test aerosol, which penetrates through openings 18 into the measuring chamber of the smoke detector 16 and, provided that the smoke detector 16 is operative, gives rise to an alarm indication.

The sleeve 2, applied to the supporting surface 15, prevents the test aerosol from emerging into the ambient space. The device therefore operates sparingly and economically, since only a very small quantity of test aerosol is necessary to actuate an operable smoke detector. In order to generate sufficient test aerosol in the interior of the upper portion 17 of the sleeve 2 of the testing device, the perforated plate 14 is maintained at a predetermined distance from member 12 by spacing rods 13. It is thus ensured that sufficient volume exists within the sleeve 2 for proper aerosol formation. This volume is advantageously chosen to be not less than the internal volume of the smoke detector 16.

FIG. 3 shows a modified embodiment wherein valve 8 is actuated by pressure of an annular plate 14*a* against the support surface 15 of the smoke detector 16. The opening of plate 14*a* is sufficient to accommodate smoke detector 16 therein without interference. Rods 13*a* are similar to rods 13 of FIGS. 1 and 2. The remaining structure of the device is as shown in FIGS. 1 and 2 and the operation is also the same as described above.

In order that the present testing device shall operate correctly the choice of the substance used to fill the spray canister 6 is very important. In known spray canisters the filling consists of a carrier medium with a boiling point below room temperature. This carrier medium is mixed with a substance of low volatility. When, after a brief interval, the carrier medium has evaporated from the aerosol particles produced by spraying, there remains a fine cloud of the added substance. The substances usually added, however, normally have undesirable characteristics. On the other hand, the substances chosen are almost always substances of poor volatility, which become deposited in the smoke detector and after a short time make the smoke detector inoperative. Frequency cleaning is therefore necessary. An adequately long persistence of the aerosol formed, without long-persistent fouling of the alarm device results if the carrier medium does not have a poorly volatile substance added to it, and if the filling of the spray canister has a boiling point in the range of −20° to +20° C. A further requirement is that this carrier medium shall have neither toxic nor corrosive effects and shall be non-combustible.

These requirements may be fulfilled, for example, by the choice of a fully halogenated hydrocarbon, or a mixture of such hydrocarbons. The desired boiling point may readily be obtained by using a mixture of halogenated hydrocarbons, of which one component is a normal, known carrier medium with a boiling point of −20° C, for example dichlorfluormethane, while the other component has a boiling point between 0° and 10° C. A substance suitable for use as this second component is dichlortetrafluorethane. With such a mixture, the release of the mixture from a relatively low pressure above atmospheric in the container to atmospheric pressure suffices to form the aerosol, while on the other

hand the persistance of the aerosol after evaporation of the lower boiling-point component is adequately long. According to the mixing ratio, the persistence of the aerosol may be adjusted as desired from a few seconds to one minute. The lower boiling-point component is then present in amounts in the range of 10 percent to 90 percent by volume of the total contents. Both simple chemical compounds and also mixtures of two or more components may be used, provided that the conditions regarding the boiling point and the remaining characteristics are fulfilled.

The embodiment shown in the drawings is a test device which is preferably built in rotationally symmetrical form and is suitable for testing smoke detectors which are mounted to a supporting surface such as surface **15** of FIG. **2**. For other types of detectors the test device must be appropriately modified. It is important, however, that the housing portion of the testing device shall enclose the whole smoke detector, while sufficient space exists within the housing for the test aerosol to be formed. In general this will be achieved if the free space within the housing, when not urged over the detector under test, is at least twice as large as the volume within the smoke detector. That is, after the test device has been applied to the smoke detector, and urged toward the detector, at least the same volume remains available for test aerosol formation as the internal volume of the smoke detector itself. The spray canister can be fitted at any desired position within the device, e.g., at the bottom, or on a side wall. In each case the spray valve must be so arranged that the nozzle emerges through an aperture into the interior of the housing of the testing device. However, it is not necessary for the spray canister to be arranged within a further portion of the housing of the device; it is possible merely to secure the spray canister completely externally of the device and to interconnect same with the activating portion of the system, although it is convenient to locate the spray canister **6** within the tube **1** of the testing device as shown in the drawings.

The actuation of the spray valve can be effected either by hand, e.g., by means of a suitable activating arrangement upon the mounting rod **5**, or automatically by the pressure of the device to be tested, as in the embodiment of FIGS. **1** and **2** described above. It may be arranged, by obvious modifications of the arrangement described, that valve actuation is effected by pressure of a part of the testing device upon the alarm device base, instead of upon the alarm device itself. The latter arrangement would be similar to that shown in FIG. **3**.

What is claimed is:

1. A device for testing the operation of smoke detector devices, comprising

a housing member (**1**, **2**) having an open portion adapted to be placed over a smoke detector device (**16**) under test, and enclosing an internal space for the generation of aerosol spray therein, and having means preventing entry of the smoke detector device into a portion of said internal space, to leave said portion unobstructed by the smoke detector device;

a spray means (**6**) including:

a container (**7**) containing a non-poisonous carrier medium liquified under pressure and having a boiling point in the range of −20° C to +20° C;

a spray valve (**8**) coupled to said container (**7**); and

means including a nozzle coupling said spray valve (**8**) into the interior of said housing member (**1**, **2**) and directing spray of said carrier medium into said portion of the internal space; and

actuating means coupled to said valve (**8**) to deliver said liquid medium as a spray into the interior of said housing member (**1**, **2**).

2. The device of claim **1** wherein said carrier medium comprises at least one fully halogenated hydrocarbon.

3. The device of claim **2** wherein said carrier medium comprises a mixture of two halogenated hydrocarbons, of which one has a boiling point below −20° C and the other of which has a boiling point between 0° C and +10° C.

4. The device of claim **3** wherein said carrier medium comprises a mixture of dichlorfluormethane and dichlortetrafluorethane.

5. The device of claim **4** wherein said carrier medium comprises between 10 percent and 90 percent by volume of dichlortetrafluorethane.

6. The device of claim **1** wherein said housing member forms a test chamber around said smoke detector under test.

7. The device of claim **1** in combination with a smoke detector wherein said portion of the internal space of said housing has a volume which is at least equal to the internal volume of the smoke detector.

8. The device of claim **1** wherein said housing member comprises a resiliently deformable bellows member (**2**) having said open portion.

9. The device of claim **1** wherein said spray valve (**8**) delivers a predetermined quantity of said liquid at each actuation thereof.

10. The device of claim **1** for application against a fixed surface wherein said actuating means operates said spray valve (**8**) in response to pressure applied to said actuating means relative to the fixed surface.

11. The device of claim **10** wherein said actuating means includes an actuator member (**12**) slideably mounted in said housing (**1**, **2**) and operatingly coupled to said spray valve (**8**); and means for moving said actuator member (**12**) to operate said valve (**8**) in response to said applied relative pressure.

12. The device of claim **11** wherein said moving means includes means engaging said smoke detector under test when said relative pressure is applied, and for moving said actuator member (**12**) responsive to said applied pressure.

13. The device of claim **1** in combination with a smoke detector device mounted on a fixed surface, wherein said actuating means operates said spray valve (**8**) in response to pressure applied to said actuating means relative to the fixed surface to which said smoke detector (**16**) under test is mounted.

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