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Method and apparatus for generating smoke aerosols

Description

5 The present invention relates to a method of generating smoke aerosols for designing, checking and demonstrating fire alarm devices, whereby a combustion material is pyrolized and, as a result, the fire aerosols are released.

10 For the proper designing, checking and demonstration of fire alarm devices it is known to conduct fire tests, in which the combustion material is heated to such an extent that a smouldering fire arises, which generates smoke. In the case of designing fire alarm devices or fire alarm

15 systems, said tests are used to determine the fastening points of the fire alarms in the property to be protected. For each property because of its geometry and air conditioning presents different flow conditions, which it is absolutely essential to take into account when designing

20 fire alarm devices. In the case of checking fire alarm devices or fire alarm systems, the tests are used to establish whether the fastening points of the fire alarms may have to be adapted to altered ambient conditions. Finally, said tests are also used to demonstrate the

25 effectiveness of a fire alarm device or a fire alarm system in order to influence the purchase decision of a potential client accordingly.

In a method of the initially mentioned type, which is

30 described in DE-C-43 29 847 (US-A-5 664 071), the temperature of the heating of the combustion material is preselected in dependence upon the heating time, wherein the combustion material is formed by a so-called test specimen, e.g. a plastic-sheathed electric cable. Said



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cable in a preheating phase is heated slowly up to the pyrolysis temperature and then the temperature is increased to the smouldering fire temperature and kept constant for a defined period by means of a current controller.

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As said known method corresponds to the pyrolysis phase and the smouldering fire phase of an electrical fire, its use is substantially limited to fire alarm devices in electrical and electronic installations, such as e.g. switchgear cabinets and the like. The smoke released during pyrolysis contains tar and other strong-smelling liquids and solids, which deposit in the interior of the building to be checked and in so doing cause permanent damage to walls, floors and equipment. Since, moreover, the assumption that the test specimen, given a constant current supply, will release a constant quantity of smoke aerosols is true only to a very qualified extent, said method is only partially capable of achieving a realistic and measurable simulation of the smoke gas flow, which develops during a fire.

In a method described in DE-A-199 26 773 for functionally testing and demonstrating fire alarm systems and smoke exhaust systems a quantity, which is determined in accordance with the room size, of a combustion material such as methanol is ignited in a fire pool, wherein the energy content may be in the order of magnitude of a nascent fire up to the limit of a developed fire. In order to make the hot gas stream also optically visible, a paraffin-aerosol cold smoke generated in a smoke generator is injected into said hot gas stream. It is obvious that said method is used, not so much for the functional testing of fire alarm systems, but far more for the testing of smoke exhaust systems. Furthermore, because the quantity of

combustion material is fixed for a start, the heat output is defined and may not be varied within the framework of functional testing. Said fixed heat output makes said method practically unsuitable for the acceptance inspection
5 of a fire alarm system and also makes it difficult to achieve the realistic simulation of various types of fire.

The object of the invention is therefore to indicate a method of the type described initially, which enables a
10 realistic simulation of fires and hence checking and demonstration of fire alarm systems under conditions which are realistic as possible. The method is moreover to assist the selection of the most appropriate fire alarms and their configuration.

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The said object is achieved according to the invention in that the combustion material is pyrolyzed by means of a combustible gas and an artificial fire is generated with an adjustable heat output, wherein for generating different
20 fire aerosols and/or different combustion gases the combustion material is freely selectable within wide limits.

In the case of the method according to the invention,
25 therefore, instead of always the same combustion material being pyrolyzed and hence only one type of aerosol being generated, the generation of different aerosols and different combustion gases is possible, thereby enabling the simulation of realistic fire situations. As the heat
30 output is adjustable, aerosols occurring in reality may easily be simulated.

A first preferred form of implementation of the method according to the invention is characterized in that with

the artificial fire a defined and reproducible hot gas stream is generated, which conveys the fire aerosols in an upward direction.

- 5 A second preferred form of implementation of the method according to the invention is characterized in that the adjustment of the heat output is effected through control of the supply of the combustible gas.
- 10 The invention further relates to an apparatus for effecting the described method, comprising a receptacle for receiving the combustion material.

The apparatus according to the invention is characterized
15 in that the receptacle is disposed above a burner connected to a gas supply, and that means of aligning and stabilizing the flame of the burner are provided.

By virtue of the burner and the gas supply the heat output
20 may be adjusted very precisely and reproducibly, and the means of aligning and stabilizing the flame of the burner enable the formation of a defined, upwardly rising hot gas stream, which entrains the smoke aerosols.

25 A first preferred form of construction of the apparatus according to the invention is characterized in that the said means comprise a jet impulse tube, which surrounds the burner and the receptacle.

30 A second preferred form of construction of the apparatus according to the invention is characterized in that the said means comprise a lid, which is provided on the receptacle and which forms or is provided with a chimney.

The lid is fastenable, preferably screw-fastenable, on the receptacle.

A third preferred form of construction of the apparatus
5 according to the invention is characterized in that the receptacle is of a crucible-like construction.

A fourth preferred form of construction is characterized in that a screen- or grating-like cover is provided on the top
10 end of the chimney.

A fifth preferred form of construction is characterized in that the burner is connected to the gas supply by a line containing at least one control valve.

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A sixth preferred form of construction of the apparatus according to the invention is characterized in that the burner, the receptacle and the jet impulse tube are surrounded by a protective cover.

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According to a further preferred form of construction the burner, the receptacle and the protective cover are so dimensioned that the apparatus is transportable in a transport container such as a case suitable for aircraft.

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There now follows a detailed description of an embodiment of the invention with reference to the single drawing, wherein the drawing shows a diagrammatic view of an apparatus according to the invention: according to the
30 drawing, said apparatus comprises a smoke generator 1 and a gas supply 2, which may be disposed e.g. on a common base plate 3. The base plate 3 may be provided with wheels 4, so that the apparatus is designed as a movable trolley.

The smoke generator 1 comprises a burner 5, a crucible-shaped receptacle 6 disposed above the burner 5 for receiving combustion material, a lid 7 covering the receptacle 6 and having a chimney 8, a jet impulse tube 9
5 surrounding the burner 5 and the receptacle 6, and a protective cover 10, into which the burner 5, the receptacle 6 and the jet impulse tube 9 are installed. The gas supply 2 is formed by a commercially available gas cylinder 11, e.g. a propane gas cylinder, and by a
10 connecting line 12 leading from the cylinder to the burner 5 and having a control valve 13. The latter is a standard pressure-keeping valve for adjusting a selectable gas pressure in the line 12 and hence also for adjusting the burner output. Under certain circumstances it is also
15 possible to provide two valves: a rough standard pressure-keeping valve for rough adjustment of the gas pressure and a fine control valve for adjustment of the burner output.

The combustion material capable of giving off the desired
20 combustion gases/smoke aerosols is introduced into the receptacle 6 and the desired burn-up power or fire load is adjusted by means of the valve 13. The combustion material may be in solid or liquid form, wherein a liquid combustion material has the advantage that with the aid of a suitable
25 dosing device, e.g. of the type used for intravenous administration of drugs, the quantity of the combustion material may be measured very precisely and introduction of the combustion material into the receptacle 6 may be automated. The lid 7 is used to suppress the oxygen supply
30 to an extent that prevents the combustion material from fully igniting and prevents flammable combustion gases from escaping in the region of the flame of the burner 5. A screen- or grating-like cover 14 disposed on the top end of

the chimney 8 serves as a safeguard to impede ignition of the combustion gases.

By means of the jet impulse tube 9 the flame of the burner
5 is stabilized and aligned and a defined hot gas stream H is generated, which rises up through the chimney 8 and entrains the smoke aerosols. The lid 7 may be fastened, e.g. screw-fastened, on the receptacle 6 to prevent the combustion gases from flowing laterally out of the reaction
10 space. In hazardous situations the burner may be switched off through interruption of the gas supply by means of the valve 13.

Practical experiments have demonstrated that, even with
15 burners 5 and receptacles 6 of relatively small dimensions and even in relatively high rooms of a height of around 10 metres, realistic fire simulations may be carried out. The dimensions for said experiments were as follows:

	* diameter of the burner 5:	50 mm
20	* diameter of the receptacle 6:	130 mm
	* diameter of the chimney 8:	42 mm
	* height of the chimney 8:	250 mm

The said experiments demonstrate that it is possible for
25 the smoke generator 1 to be designed as a portable appliance and of such dimensions that it may be accommodated together with the base plate 3 and the gas line 12 having the valve 13 in a transport case suitable for aircraft. The gas cylinder 11 would naturally not be
30 transported in the same case.

The area of application of the smoke generator includes acceptance tests, repeat tests, demonstrations and the designing of fire alarm systems (positioning, selection and

configuration of fire alarms) also under difficult ambient conditions.

Claims

1. Method of generating smoke aerosols for designing,
checking or demonstrating fire alarm devices, whereby
5 a combustion material is pyrolyzed and as a result the
fire aerosols are released, characterized in that the
combustion material is pyrolyzed by means of a
combustible gas and an artificial fire is generated
with an adjustable heat output, wherein for generating
10 different fire aerosols and/or different combustion
gases the combustion material is freely selectable
within wide limits.
2. Method according to claim 1, characterized in that
15 with the artificial fire a defined and reproducible
hot gas stream (H) is generated, which conveys the
fire aerosols in an upward direction.
3. Method according to claim 2, characterized in that the
20 adjustment of the heat output is effected through
control of the supply of the combustible gas.
4. Apparatus for effecting the method according to one of
claims 1 to 3, comprising a receptacle (6) for
25 receiving the combustion material, characterized in
that the receptacle (6) is disposed above a burner (5)
connected to a gas supply (11), and that means of
aligning and stabilizing the flame of the burner (5)
are provided.
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5. Apparatus according to claim 4, characterized in that
the said means comprise a jet impulse tube (9), which
surrounds the burner (5) and the receptacle (6).

6. Apparatus according to claim 5, characterized in that the said means comprise a lid (7), which is provided on the receptacle (6) and which forms or is provided with a chimney (8).
- 5 7. Apparatus according to claim 6 or 7, characterized in that the lid (7) is fastenable, preferably screw-fastenable, on the receptacle (6).
- 10 8. Apparatus according to one of claims 4 to 7, characterized in that the receptacle (6) is of a crucible-like construction.
9. Apparatus according to one of claims 6 to 8,
15 characterized in that a screen- or grating-like cover (14) is provided on the top end of the chimney (8).
10. Apparatus according to one of claims 4 to 9, characterized in that the burner (5) is connected to
20 the gas supply (11) by a line (12) containing at least one control valve (13).
11. Apparatus according to one of claims 5 to 10, characterized in that the burner (5), the receptacle
25 (6) and the jet impulse tube (9) are surrounded by a protective cover (10).
12. Apparatus according to claim 11, characterized in that the burner (5), the receptacle (6), the jet impulse
30 tube (9) and the protective cover (10) are so dimensioned that the apparatus is transportable in a transport container such as a case suitable for aircraft.