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D4 : US 5520826 A (REED JR. et al) 28 May 1996
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(54) Title: NEW METHOD FOR EXTINGUISHING FIRE

(54) 发明名称: 一种新型灭火方法

(57) Abstract: The present invention provides a new method for extinguishing a fire, characterized in that a pyrotechnic composition is used as a heat source (energy) and power source (driving gas); during use, by igniting the pyrotechnic composition, the high temperature generated by the combustion of the pyrotechnic composition is utilized to make a fire extinguishing material produce a large amount of fire extinguishing substance, which is sprayed out together with the pyrotechnic composition, so as to achieve the purpose of extinguishing a fire. As compared with conventional aerosol fire extinguishing systems, gas fire extinguishing systems and water type fire extinguishing systems, the fire extinguishing method of the present invention is more efficient and safer.

(57) 摘要: 本发明提供了一种新型灭火方法, 其特征在于: 以烟火类药剂为热力源(能量)和动力源(驱动气体), 在使用时, 通过点燃烟火类药剂, 利用烟火类药剂燃烧产生的高温使灭火组合物产生出大量的灭火物质, 随烟火类药剂一起喷出而达到灭火目的。与传统的气溶胶灭火系统、气体灭火系统、水系灭火系统相比, 本发明的灭火方法更高效、更安全。

New Method for Extinguishing Fire

Technical Field

The invention belongs to the field of new fire extinguishing technology and relates to a new method for extinguishing fire.

Background Art

Fires cause significant losses of people's lives and property. Existing fire extinguishing methods mainly include the follows. First, directly extinguish fire by making use of compressed gas, for example, gas fire extinguishers. Gases commonly used include carbon dioxide, IG541, etc. This fire extinguishing method has shortcomings such as inferior fire extinguishing efficiency, cumbersome device, and high cost for maintenance. Second, spray out fire extinguishing substance by compressed gas to extinguish fire, for example, pressurized dry powder fire extinguisher that sprays out the dry powder by using compressed gas to extinguish fire, a foam extinguisher that sprays out foam by using compressed gas to extinguish fire, heptafluoropropane extinguisher that sprays out heptafluoropropane by using compressed gas to extinguish fire. This fire extinguishing method also needs compressed gas, so there is a high requirement to the pressure resistance of the device, and the cost for maintenance is high as well. Third, extinguish fire by using pressurized water, for example, water spraying fire extinguisher that directly extinguish fire by using water flow or water spray. The drawback of this fire extinguishing method is that it has a poor extinguishing efficiency and cannot be used for extinguishing fire of electrical equipment. Fourth, extinguish fire by combusting a pulse agent to spray out fire extinguishing substance, for example, a pulse dry powder fire extinguisher that sprays out dry powder by using a large amount of gas generated instantly when the pyrotechnic agent combusts. This fire extinguishing method leads to a loud noise when spraying and is potentially hazardous to some extent. Fifth, extinguish fire by using the pyrotechnic agent to generate a fire extinguishing substance, for example, an aerosol fire extinguisher that extinguishes fire by using a

large quantity of gas, water vapor and particles generated by the combustion of a pyrotechnic material. The drawback of this fire extinguishing method is that a large amount of heat is generated by the combustion of the pyrotechnic agent, and it may cause secondary combustion of the combustible if the fire extinguishing device is not provided with a cooling system, while a fire extinguishing device provided with a cooling system is cumbersome.

Summary of the Invention

The present invention provides a novel fire extinguishing method different from the above-mentioned conventional fire extinguishing methods.

In one aspect the present invention provides a method for extinguishing fire, including the steps of providing a pyrotechnic agent and a fire extinguishing composition, wherein the pyrotechnic agent is used as a heat source (energy) and a power source (driving gas) and wherein the fire extinguishing composition generates a fire extinguishing substance while being heated; wherein during use, the pyrotechnic agent is ignited at first, and the high temperature generated by the combustion of the pyrotechnic agent is utilized to make the fire extinguishing composition produce a large amount of fire extinguishing substance, which is sprayed out together with the pyrotechnic agent, so as to achieve the purpose of extinguishing a fire.

As we know, the essence of flame burning is a redox reaction occurring between an oxidant and a reducing agent. The flame itself is plasma composed of positive ions, negative ions, electrons, atoms, molecules, etc. Taking the combustion of hydrogen for example, the reaction mechanism is as follows:





Wherein formulae (1) - (4) are chain propagation processes, formulae (5) - (7) are chain termination processes, and M represents a substance annihilates radicals. Actual combustion process is even more complicated. No matter what kind of extinguishing method is adopted, the essence is to block the chain reaction of radicals and make the rate of generating radicals slower than the rate of annihilating the radicals.

The thought of the present invention is as follows: a fire extinguishing

composition is composed of chemical substance that is apt to generate fire extinguishing substance while being heated, a processing aid and an adhesive (it is also possible not to add the processing aid or adhesive); a pyrotechnic agent or an aerosol generator is used as a heat source (energy) and a power source (driving gas) so that the fire extinguishing composition releases chemical substance that can block the chain reaction of the flame burning; the released fire-extinguishing chemical substance is utilized to extinguish fire.

According to the present invention, the chemical substance that is apt to generate fire extinguishing substance while being heated includes the following:

1) A compound or fire-extinguishing composition which, while being heated, is apt to decompose and release gas, liquid or solid particles that can extinguish fire.

Said compound includes carbonates, bicarbonates, subcarbonate of alkali metal and alkaline earth metal, a brominated flame retardant, a chlorinated flame retardant, organic phosphorus flame retardant, a phosphorus-halogenated flame retardant, a nitrogen flame retardant and phosphorus-nitrogen flame retardant, an inorganic flame retardant, and so on.

2) Elementary substance, compound or fire-extinguishing composition that, while being heated, is apt to sublimate to generate fire extinguishing substance.

Said elementary substance or compound includes iodine, ferrocene, ferrocene derivatives, halogenated aliphatic hydrocarbon and halogenated aromatic hydrocarbon having a melting point of 50°C or higher, and so on.

3) Fire-extinguishing composition that undergoes a chemical reaction while being heated to generate a reaction product that can effectively extinguish fire.

The chemical reaction mentioned here refers to a chemical reaction that may occur between the component substances, and it is generally a redox reaction.

Said fire extinguishing composition includes a composition that can undergo a redox reaction, for example, a mixture of an oxidant such as potassium nitrate, sodium nitrate, etc., a reducing agent such as charcoal, a phenolic resin, etc., and noncombustible substance such as sodium chloride, potassium chloride, potassium

carbonate, potassium bicarbonate, etc. When the composition is heated, a redox reaction can take place between the oxidant and the reducing agent, generating a fire extinguishing substance that extinguishes fire, but the composition itself does not combust. Accordingly, it is not equivalent to the aerosol generator in the conventional sense.

4) A novel composition composed of two or three of the above-mentioned groups of chemical substances.

In the present invention, the fire extinguishing composition can be made into spherical, cubic or irregular shape, preferably spherical shape.

In the present invention, the fire extinguishing composition can be solid or honeycomb, preferably honeycomb.

In the present invention, the fire extinguishing composition has a particle size of less than 20mm, preferably 1-10mm.

The fire extinguishing method of the present invention is advantageous in that it greatly improves the fire extinguishing efficiency as compared with the conventional aerosol fire extinguisher. Moreover, the fire extinguishing composition can significantly take away the heat generated by the combustion of pyrotechnic agent, so the fire extinguishing device has a lower temperature at the nozzle and therefore is safe to use.

Description of Embodiments

Example 1

40 mass% of zinc carbonate, 50 mass% of potassium carbonate and 10 mass% of microcrystalline paraffin wax are uniformly mixed. The mixture is made into pellets by a tableting machine. A certain amount of said pellets are placed between the nozzle of a fire extinguisher and a pyrotechnic agent, to form a simple and new type of fire extinguisher.

The pyrotechnic agent is ignited, and the heat thus generated makes zinc

carbonate decompose into zinc oxide and carbon dioxide that can extinguish fire. Gases generated during the combustion of the aerosol generator spray out the decomposition products. The concentration-distribution fire-extinguishing test result is shown in Table 1.

Example 2

A certain amount of iodine are placed between the nozzle of the fire extinguisher and the pyrotechnic agent, to form a simple and new type of fire extinguisher.

The pyrotechnic agent is ignited, and the heat thus generated makes the iodine sublimate. Gases generated during the combustion of the aerosol generator spray out the sublimated substance. The concentration-distribution fire-extinguishing test result is shown in Table 1.

Example 3

10 mass% of potassium nitrate, 15 mass% of phenolic resin, 55 mass% of sodium chloride, 15 mass% of hydroxyl-terminated polybutadiene, 5 mass% of toluene diisocyanate are uniformly mixed. The mixture is poured to form prism honeycomb that is cured and processed into a bulk honeycomb. A certain amount of said bulk agent is placed between the nozzle of the fire extinguisher and the pyrotechnic agent, to form a simple and new type of fire extinguisher.

The pyrotechnic agent is ignited, and the heat thus generated makes potassium nitrate react with phenolic resin, hydroxyl-terminated polybutadiene and toluene diisocyanate, to generate substances such as carbon dioxide, nitrogen, potassium carbonate particles that can extinguish fire, etc. Gases generated during the combustion of the aerosol generator spray out the generated products. The concentration-distribution fire-extinguishing test result is shown in Table 1, Table 2 and Table 3.

Table 1 Assembly method and fire-extinguishing effects of the simple and new type of fire extinguishers

(Using an S-type aerosol generator as the power source and heat source)**

| Type/mass (g) of pyrotechnic agent | Type/mass (g) of fire-extinguishing chemical substance | Average fire-extinguishing number* | Highest temperature at nozzle (°C) | Remarks |
|--|---|------------------------------------|------------------------------------|------------------|
| Commercially available S-type aerosol generator/50 | | 1.2 | 1250 | Comparative test |
| Commercially available S-type aerosol generator/50 | Fire-extinguishing composition in Example 1/50 | 2.2 | 610 | |
| Commercially available S-type aerosol generator/50 | Fire-extinguishing elementary substance in Example 2/50 | 3.6 | 465 | |
| Commercially available S-type aerosol generator/50 | Fire-extinguishing composition in Example 3/50 | 2.8 | 830 | |

* average value of five parallel tests

Table 2 Assembly method and fire-extinguishing effects of the simple and new type of fire extinguishers

(Using a K-type aerosol generator as the power source and heat source)**

| Type/mass (g) of pyrotechnic agent | Type/mass (g) of fire-extinguishing chemical substance | Average fire-extinguishing number* | Highest temperature at nozzle (°C) | Remarks |
|------------------------------------|--|------------------------------------|------------------------------------|-------------|
| Commercially | | 2.6 | 790 | Comparative |

| | | | | |
|--|---|-----|-----|------|
| available S-type aerosol generator/15 | | | | test |
| Commercially available K-type aerosol generator/15 | Fire-extinguishing composition in Example 1/50 | 4.2 | 430 | |
| Commercially available K-type aerosol generator/15 | Fire-extinguishing elementary substance in Example 2/50 | 4.8 | 355 | |
| Commercially available K-type aerosol generator/15 | Fire-extinguishing composition in Example 3/50 | 4.4 | 640 | |

* average value of five parallel tests

Table 3 Assembly method and fire-extinguishing effects of the simple and new type of fire extinguishers

(Using an aerosol generator as the power source and heat source)**

| Type/mass (g) of pyrotechnic agent | Type/mass (g) of fire-extinguishing chemical substance | Average fire-extinguishing number* | Highest temperature at nozzle (°C) | Remarks |
|--|--|------------------------------------|------------------------------------|------------------|
| Commercially available pyrotechnic agent/100 | | 0 | 960 | Comparative test |
| Commercially available K-type aerosol | Fire-extinguishing composition in Example 1/50 | 1.8 | 520 | |

| | | | | |
|---|---|-----|-----|--|
| generator/100 | | | | |
| Commercially available K-type aerosol generator/100 | Fire-extinguishing elementary substance in Example 2/50 | 3.0 | 395 | |
| Commercially available K-type aerosol generator/100 | Fire-extinguishing composition in Example 3/50 | 2.2 | 690 | |

* average value of five parallel tests

** Fire extinguishing model

A test model is made with reference to 7.13 Concentration-distribution test of Part 1 – Thermal aerosol fire extinguishing device of the Aerosol Fire Extinguishing System (GA499.1-2004), and a test process according to this is adopted.

The test chamber is a cube having an inner side length of 1 m. With reference to the front door of the test chamber, one fuel tank having an inner diameter of 30 mm and a height of 100 mm is placed at each of the upper left front part, the upper right rear part, the lower left rear part, the lower right front part, and the back of baffle in the test chamber. The fuel used is n-heptane. Ignite n-heptane, allow it to pre-burn for 30 seconds, close the door of the test chamber, and start a simple and new type fire extinguisher to extinguish fire.

Open the test chamber 30 seconds later after the completion of the ejection of the fire extinguisher. Calculate an average fire-extinguishing number based on the fire-extinguishing number of five parallel tests.

The Claims Defining the Invention are as Follows:

1. A method for extinguishing fire, wherein a pyrotechnic agent is used as a heat source (energy) and a power source (driving gas); during use, the pyrotechnic agent is ignited at first, and the high temperature generated by the combustion of the pyrotechnic agent is utilized to make a fire extinguishing composition produce a large amount of fire extinguishing substance, which is sprayed out together with the pyrotechnic agent, so as to achieve the purpose of extinguishing a fire.

2. The fire extinguishing method according to claim 1, wherein the pyrotechnic agent is a pyrotechnic aerosol fire extinguishing agent.

3. The fire extinguishing method according to claim 1 or 2, wherein the fire extinguishing composition includes chemical substance that is apt to decompose while being heated and can release gas, liquid or solid particles that can extinguish fire.

4. The fire extinguishing method according to claim 1 or 2, wherein the fire extinguishing composition includes chemical substance that is apt to sublimate while being heated and can extinguish fire after sublimating.

5. The fire extinguishing method according to claim 1 or 2, wherein the fire extinguishing composition includes chemical substance which undergoes a chemical reaction between the heated components to generate reaction product that can extinguish fire.

6. A method for extinguishing a fire according to claim 1, substantially as herein described with reference to any one or more of the Examples.