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(54) **EXTINGUISHING APPARATUS FOR EXTINGUISHING FIRES**

(57) The invention relates to a double-action extinguishing apparatus for extinguishing fires comprising an atomized liquid system and an aerosol dispensing system based on inorganic salts.

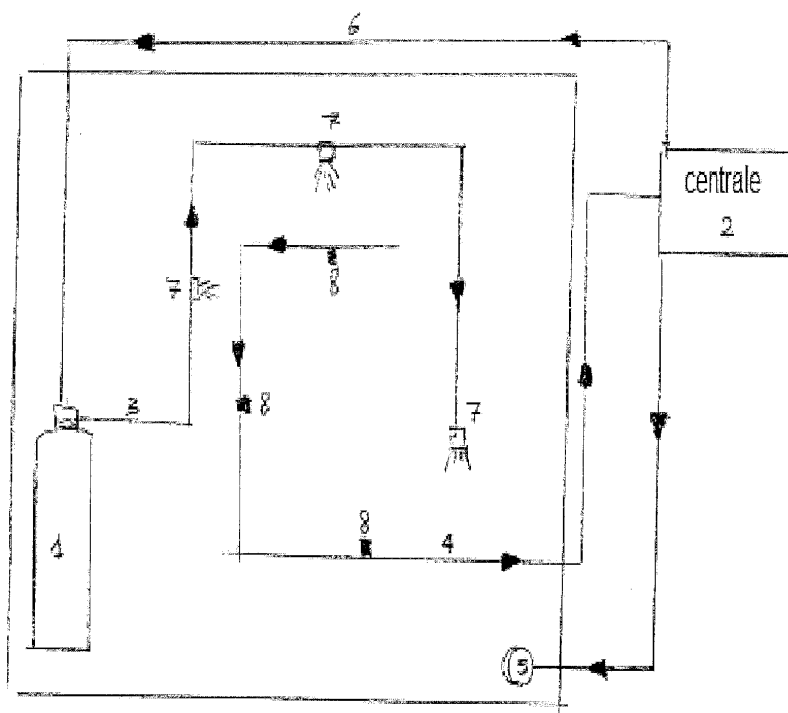


Fig. 1

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Description

Technical field of the Invention

[0001] The present invention relates to an extinguishing apparatus for extinguishing fires.

[0002] In particular, the invention concerns a double-action extinguishing apparatus for extinguishing fires comprising an atomized liquid system and an aerosol dispensing system based on inorganic salts.

Background of the Invention

[0003] Different products are known to be used in the field of the extinguishing apparatus, the latter being classified according to the extinguishing agent being employed.

[0004] The most common category of extinguishing apparatus exploits an aerosol, that is a mixture comprising a gaseous medium wherein extinguishing agents in a solid form are dispersed.

[0005] A common aerosol extinguishing apparatus acts by means of an ultrafine dispersion of the extinguishing agent due to its evaporation, followed by the condensation thereof. The aerosol system, for its ability to spread in the atmosphere is similar to a gas and therefore is a suitable means for extinguishing fires.

A limit to this kind of extinguishing apparatus arises when the temperature is relatively high. In such operative conditions, an aerosol is quickly subjected to condensation and its extinguishing ability is compromised.

[0006] Alternative extinguishing systems are based on the use of atomized water. The main effects carried out by water in the form of very fine drops are cooling, inertization and blocking the radiant heat.

[0007] The Applicant points out that an atomized water system shows some limits as regards its diffusion in the surrounding environment. The properties of the atomized water are not similar to those of a gas or aerosol system, so that the diffusion modality and the extinguishing power of fires are lower when comparing these two alternative systems.

[0008] As a consequence, a further limitation is given by the precautions to be taken into account in the design of an anti-fire plant based on atomized water. More specifically, in order to achieve an optimal distribution of the atomized liquid it is needed to arrange special spray nozzles at pre-set heights, depending on the presence of structural and mobile obstacles, which are able to oppose its diffusion.

[0009] These and other drawbacks can occur in closed rooms, such as a motor compartment of a vehicle, for example a bus, boats, etc.

[0010] It is therefore felt the need to overcome the drawbacks of the above prior art providing an apparatus capable of extinguishing fires in an efficient way and in different operative conditions, such as for instance closed rooms and/or high temperatures rooms.

Summary of the Invention

[0011] It is therefore a first object of the present invention an extinguishing apparatus having a combined action, and comprising both an atomized water system and an aerosol system based on organic salts, this extinguishing apparatus being continuously managed by a control unit.

[0012] A second object of the invention is to make available in the field of fires extinguishing in closed and narrow rooms, a reliable method for extinguishing fires comprising a sequence of steps from a) to e), as successively defined in the present description.

[0013] A first advantage of the present invention is to provide an extinguishing apparatus and an extinguishing method, which are able to extinguish fires at high temperatures and in closed and narrow rooms, such as for instance the motor compartment of a vehicle. For the purposes of this patent application, "high temperatures" are meant temperature values equal to or greater than 200 °C.

[0014] Another advantage of the present invention is to provide an extinguishing apparatus and an extinguishing method, which are able to promptly decrease the temperatures in places affected by a fire, as well as to reduce the presence of flammable gases. Moreover, the extinguishing apparatus and method according to the invention allow reaching efficiently each portion of the volume affected by the fire.

[0015] Further objects and advantages will become apparent from the following detailed description of the invention, also with reference to the preferred embodiments, although it can be understood that variants of present invention may be made without departing from the scope of protection defined by the appended claims and referring to the accompanying drawings.

Short description of the Figure

[0016] Figure 1 shows the extinguishing apparatus according to the present invention.

Detailed description of the invention

[0017] With a particular reference to Figure 1, a preferred embodiment of the apparatus according to the invention is described.

[0018] The extinguishing apparatus for extinguishing fires of present invention comprises:

- i) a control unit 2 for processing temperature data supplied by at least one heat sensor 8 connected thereto;
- ii) a system for atomizing and dispensing the atomized liquid, which can be activated by means of a signal from the control unit 2;
- iii) an aerosol dispensing system 5 which can be activated by means of a signal from the control unit 2

and comprising a tank provided with a dispenser comprising an extinguishing agent in the form of an inert gas, a foam or a powder for the generation of said aerosol.

[0019] According to a preferred embodiment of the invention, the extinguishing apparatus operates in automatic mode and is thus managed by a control or central unit 2 acquiring data from one or more heat sensors 8, conveniently located inside the volume wherein the anti-fire action is aimed to be achieved. Generally, sensors 8 are located along a line fitting to the shape of the volume to be monitored, also denominated sensors line 4.

[0020] The connection between sensors 8 and control unit 2 may be physical or wireless. According to a preferred embodiment, the invention uses a physical connection by means of one or more electric wires.

[0021] By way of a non-limitative example, three sensors may be placed in a volume of about 6 m³, preferably at a similar distance each other or distributed in a way to monitor the various microenvironments defined by any bodies present within the volume.

[0022] The control unit 2 is activated when the data received by thermal sensors 8 differ from the reference values in a significant way. The control unit 2 is managed so as to compare temperature data coming from at least a heat sensor 8 with a pre-set temperature threshold value. According to a preferred embodiment of the invention, this pre-set threshold temperature value is comprised between 130°C and 150°C, preferably between 140°C e 145°C.

[0023] The reference value refers to the heat amount exchanged for unit of surface and time in standard conditions, that is to say in the absence of fires. Generally, in the absence of fires the temperature does not exceed 120°C.

[0024] The starting of a fire is considered responsible of such an increase in the heat exchange measured by the sensor, or such a temperature variation. For this reason, at the occurrence of this increase, the control unit 2 transmits activation signals respectively to the system for atomizing and dispensing an atomized liquid and to the aerosol dispensing system.

[0025] Thermal sensors may be of different types, such as integrated thermoelectric sensors, sensors based on semiconductor junctions or thermo-mechanical sensors. In any case, the relevant data for the activation of the extinguishing apparatus is correlated to a significant temperature increase in the volume wherein the apparatus operates.

[0026] The activation of the apparatus involves the transmission of a signal 6 from the control unit 2 to a cylinder 1 containing a liquid, preferably an aqueous solution of an extinguishing agent. The extinguishing agent is selected from the substances known for the extinguishing properties or combination thereof. This agent may be present in the aforementioned aqueous solution in a concentration ranging from 1% to 8% by weight, preferably

from 2 to 5% by weight.

[0027] The cylinder 1 is equipped with an electrovalve to activate it. The volume of cylinder 1 increases as a function of the volume where fires have to be counteracted. For example, in a volume of 5 m³ a cylinder of about 3 liters can be used. The cylinders used are commercial cylinders, commonly used for water or similar fire extinguishers.

[0028] The transmitted signal starts the water atomization by means of a dedicated nebulizer; the atomized water flows into the pipe 3 until reaching the nozzles 7 from which it emerges.

[0029] In a preferred embodiment of the invention a stainless steel AISI 316 tube was used. Similar tubes can be used remaining inside the scope of present patent application.

[0030] The pipe 3 has a variable length and diameter according to the volume in which the fire-fighting apparatus operates. Generally, in environments of the type of the above given example, the pipe reaches lengths equal to 4 meters and has a diameter from 8 to 10 millimeters.

[0031] The number of nozzles is strongly influenced by the presence of obstacles that prevent the distribution of the atomized liquid inside the entire volume, and the arrangement of the nozzles does not necessarily need to be regular.

[0032] As it is evident from the above description, the atomizing and dispensing system of atomized liquid comprises a cylinder 1 containing an aqueous solution of an extinguishing agent, a valve, pipes connected to the cylinder 1 by a solenoid valve and provided with one or more nozzles 7 for the emission of the atomized solution. The function performed by the atomized water is to decrease the temperature and the flammable gases.

[0033] Once a predetermined time has elapsed since the activation of the atomization system, or when a predetermined signal has been detected by the thermal sensors, the control unit sends a second signal to the aerosol dispenser. Said second signal is generally provided after a period of about 10-15 seconds starting from the activation of the atomization system.

[0034] Once received the signal from the control unit 2, the aerosol dispensing system 5 provides for the delivery of the gaseous mixture containing one or more extinguishing substances dispersed in a solid phase. Extinguishing substances are substances known to suppress fire and /or inhibit combustion. The extinguishing agents are generally used in the form of inert gases, foams or powders for the generation of aerosols.

[0035] In a preferred embodiment of the invention, the extinguishing agent used in the aerosol dispensing system 5 is a potassium-based solid compound, preferably potassium bicarbonate or potassium nitrate.

[0036] The aerosol dispensing system 5 comprises a container for the aerosol emission containing at least one extinguishing agent and an electric wire for transmitting the signal from the control unit 2.

[0037] The above described extinguishing apparatus

involves the implementation of a method for extinguishing fires comprising the following steps:

- a) planning a control unit 2 with a temperature threshold value;
- b) acquiring temperature data by means of at least one heat sensor 8;
- c) comparing said temperature data with said temperature threshold value by means of said control unit 2;

if the measured temperature exceeds said temperature threshold value, the method comprises the following further steps:

- d) activating, upon emission of a signal coming from said control unit 2, the system for atomizing and dispensing an atomized liquid;
- e) activating, upon emission of a signal coming from said control unit 2, the aerosol dispensing system 5.

[0038] According to an embodiment of the extinguishing method mentioned above, step e) follows step d) with a time delay ranging from 5 to 45 seconds, preferably from 10 to 25 seconds.

[0039] As previously stated, the threshold temperature value is generally preset at values between 130°C and 150°C, preferably between 140°C and 145°C.

[0040] For the purposes of the present invention, "reference volume" means the volume of the environment wherein the extinguishing apparatus carries out the fire-fighting function.

[0041] The control unit 2, by means of the sensors 8, detects the start of the fire and activates the extinguishing system. In this step the water atomization system will be first activated.

[0042] Subsequently, at different times, the aerosol extinguishing system based on potassium salts will be activated automatically.

[0043] The aerosol action will be immediately effective on eventual residual outbreaks, finding neither high temperatures nor vapors.

[0044] The aerosol is more effective at the decrease of the temperature and in the absence of vapors. The fact that the atomized water supply precedes the aerosol delivery optimizes the operating conditions in which the latter acts. In fact, the discharge of atomized water reduces the irradiation of the heat by suddenly lowering the temperatures. The reasons underlying this phenomenon lie in the following factors:

- greater extension of the wet surface;
- increase in the depth of penetration;
- quick vapor reduction;
- the fast reduction of heat substantially reduces the risk of spontaneous re-ignition and combustion of the surrounding infrastructures;
- fume reduction;

- interruption of the free radicals chain reaction.

[0045] It derives also a reduction in the danger of explosion along with the danger of fire re-ignition and formation of sparks. Atomized liquid is neither toxic nor harmful to the environment; it is not corrosive on metals, rubbery materials and plastics.

[0046] One of the advantages of the present invention lies in the fact that after the fire is extinguished, there will be no solid residues on the surfaces concerned.

[0047] The combination of the two types of extinction devices gives the present invention a synergistic effect and achieves surprising results.

[0048] As described above, the known extinguishing systems based on atomized water must take into account in the design phase of different constraints dictated by the geometry of the space to be protected. It is clear how much it is difficult to design a priori a system of maximum efficiency, without knowing the location of any trigger of fire, especially if this is generated in an area difficult to access.

[0049] The present invention exploits the advantages of the atomization extinguishing systems and resolves the limits thereof by a specific implementation combined with an aerosol extinguishing system, which is suitably activated to compensate the deficiencies of the first system and to complete the extinguishing of a fire. This result is also obtained in those cases where the spray nozzles are posteriorly positioned inefficiently and the fire principle is not attainable.

[0050] A further advantage of the combined system lies in the fact that small and not too large cylinders are sufficient, thus reducing their weight and sizes, and making it easier their positioning. In addition, it is not necessary to charge the cylinders with high pressure and use a large number of nozzles. For the purposes of the present invention, by way of a non-limiting example, it may in fact be sufficient to use a single cylinder at a charge pressures equal to 40 BAR.

[0051] The present invention is particularly advantageous for extinguishing fires generated in the engine compartment, lithium battery compartment, and preheater compartment of civil, military, railway vehicles, agricultural and construction machinery, turbines, industrial kitchens.

[0052] The apparatus described above is suitable for fire classes A, B, C, D.

[0053] The particular embodiments herewith described do not limit the content of this application, which covers all the variants of the invention defined by the appended claims.

Claims

1. Extinguishing apparatus for extinguishing fires comprising:

- i) a control unit (2) for processing temperature data supplied by at least one heat sensor (8) connected thereto;
- ii) a system for atomizing and dispensing the atomized liquid, which can be activated by means of a signal from the control unit (2);
- iii) an aerosol dispensing system (5) which can be activated by means of a signal from the control unit (2) and comprising a tank provided with a dispenser comprising an extinguishing agent in the form of an inert gas, a foam or a powder for the generation of said aerosol.
2. Extinguishing apparatus according to claim 1, **characterized in that** said system ii) for atomizing and dispensing the atomized liquid comprises a cylinder (1) containing an aqueous solution of extinguishing agent, pipes (3) connected to said cylinder (1) by means of a solenoid valve and provided with at least one nozzle (7) for dispensing said atomized liquid.
3. Extinguishing apparatus according to claim 2, **characterized in that** said aqueous solution comprises an extinguishing agent in a concentration comprised from 1% to 8% by weight.
4. Extinguishing apparatus according to anyone of the previous claims, **characterized in that** said extinguishing agent is potassium bicarbonate or potassium nitrate.
5. Extinguishing apparatus according to anyone of the previous claims, **characterized in that** said control unit (2) is managed so as to compare temperature data coming from at least a heat sensor (8) with a preset temperature threshold value.
6. Method for extinguishing fires comprising the following steps:
- a) planning a control unit (2) with a temperature threshold value;
- b) acquiring temperature data by means of at least one heat sensor (8);
- c) comparing said temperature data with said temperature threshold value by means of said control unit (2);
- if the measured temperature exceeds said temperature threshold value, the method comprises the following further steps:
- d) activating, upon emission of a signal coming from said control unit (2), the system for atomizing and dispensing an atomized liquid;
- e) activating, upon emission of a signal coming from said control unit (2), the aerosol dispensing system (5).
7. Method for extinguishing fires according to claim 6, wherein said step e) follows said step d) with a time delay ranging from 5 to 45 seconds.
8. Method for extinguishing fires according to claim 7, wherein said time delay ranges from 10 to 25 seconds.
9. Method for extinguishing fires according to anyone of claims 6-8, wherein said temperature threshold value is preset at a value ranging from 130°C and 150°C.
10. Use of the extinguishing apparatus according to claims 1-5 for extinguishing fires generated in the engine compartment, lithium battery compartment, preheater compartment of civil, military, railway vehicles, agricultural and construction machinery, turbines, industrial kitchens.

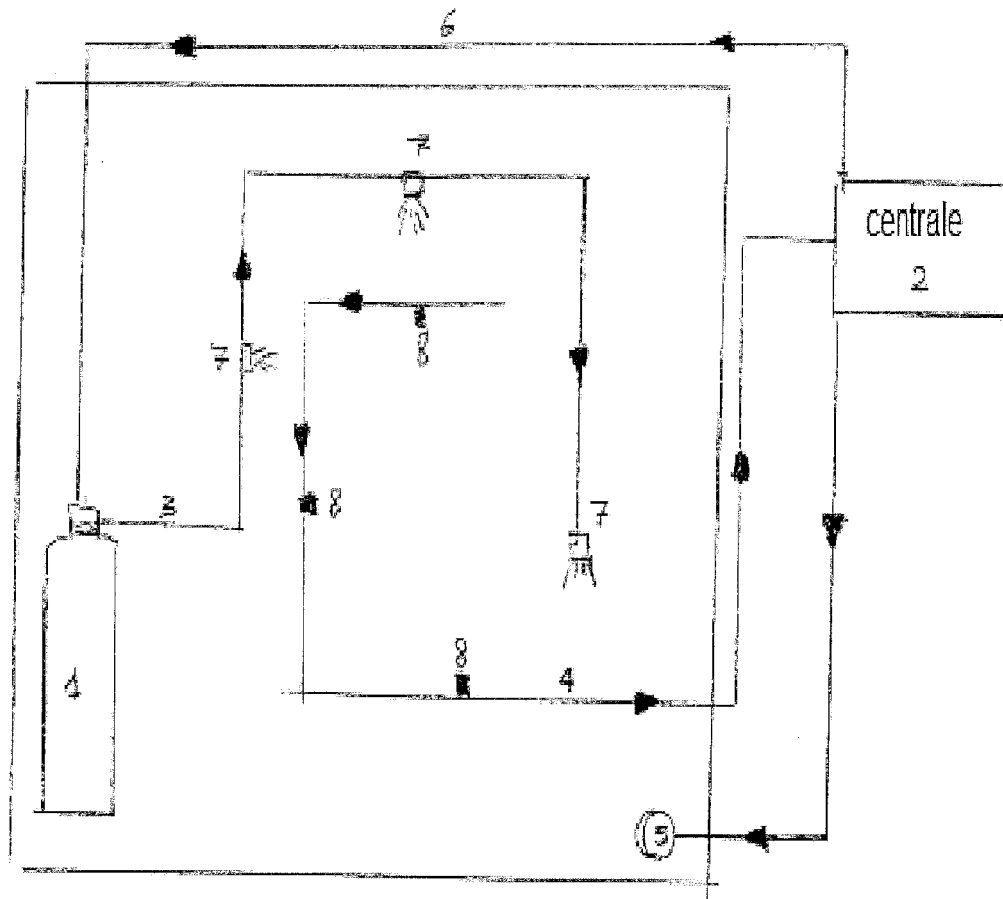


Fig. 1



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Application Number
EP 18 20 4717

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CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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