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(54) Fire-fighting system

(57) A fire-fighting system, has a network for the distribution of inert gas into a closed environment (1) through injection points (6); a plurality of sampling points (4) that take samples of atmosphere in the closed environment (1) in order to measure the quantity of oxygen that is present; an inert gas generator (9) connected to the injection points (6) and an oxygen analyzer (12) connected to the sampling points (4); the inert gas generator (9) is controlled by the oxygen analyzer (12) so as to send inert gas to the injection points (6) when the oxygen content measured by the sampling points (4) exceeds a preset value; a virtual grid (2) divides the environment (1) into a plurality of regions having variable dimensions: smaller regions at openings (3, 33) of said environment toward the outside, and larger regions where there are no openings; each region has at least one injection point (6) and at least one sampling point (4); the sampling point (4) of each region is distant from the respective injection point (6).

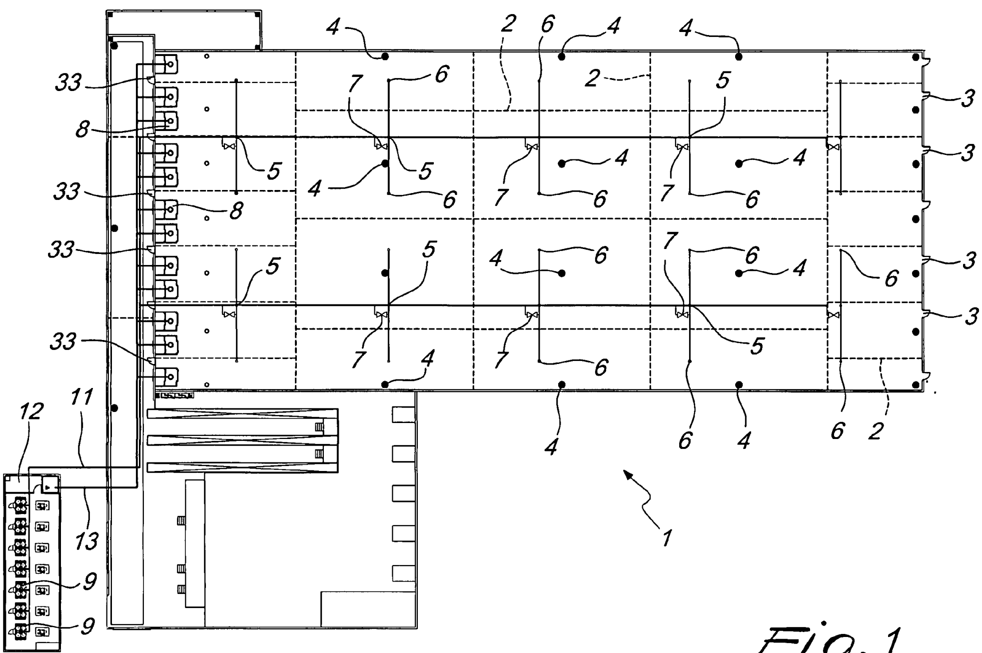

Fig. 1

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Description

[0001] The present invention relates to a fire-fighting system.

[0002] In recent times, the use of nitrogen as an inerting gas to provide effective fire prevention, within environments to be protected, is becoming widespread.

[0003] As is known, by lowering the level of the oxygen, in an environment, below a minimum initiation level, it is in fact possible to prevent and completely eliminate the risk that a combustion process might occur.

[0004] In practice, it is possible to create environments that are characterized by a low content of internal oxygen and in which it is not possible to establish or maintain any combustion process.

[0005] There is already abundant technical documentation produced by various research laboratories which, by virtue of initiation tests performed according to standards, have verified and certified in an extremely precise manner the initiation threshold of combustion processes for a very large number of commonly used materials.

[0006] It has been found that the minimum residual oxygen threshold required for the initiation of combustion processes for most materials is well above the minimum survival threshold for man.

[0007] This observation has allowed to design environments that are perfectly compatible with human presence and at the same time are perfectly safe with respect to the risk of fire.

[0008] The advantages of this prevention method, which eliminates completely the risk of damage due to fire, are evident; however, its practical application has revealed some limitations and drawbacks.

[0009] Currently, regardless of the size of the enclosed space to be protected, the detection of the residual oxygen values inside the enclosed space is performed by means of sensors which draw the air to be analyzed simultaneously from multiple intakes. The air is mixed unintentionally within the sampling duct and is analyzed.

[0010] The residual oxygen value obtained from the analysis is then compared with an objective value, and if the objective value is lower than the found value the mechanism for introducing nitrogen into the environment is activated.

[0011] The arrangement of the sensors, in the applications known so far, does not allow to check specifically any inflows of air from outside.

[0012] In practice, only in the most refined solutions sensors are used which, as explained above, collect and mix in the collection duct the samples of multiple sampling points.

[0013] Moreover, the sensors and/or points for sampling from the environment to be protected are distributed on the walls in a more or less constant manner.

[0014] In conventional systems, the introduction of nitrogen into the environment occurs always at a delivery point, regardless of the size of the environment to be protected, assuming that the nitrogen introduced in the enclosed space, due to the known physical property of gases, tends to mix with the gas that is present within the environment to be protected and tends to create a mix that has a more or less constant residual oxygen content.

[0015] However, in practice this does not occur due to at least three factors.

[0016] The first factor relates to the fact that the mixing of the nitrogen introduced at the delivery point with the remainder of the atmosphere inside the environment occurs in a non-negligible finite time, which is directly proportional to the size of the environment. Because of this, at each instant within environments of medium or large size there are residual oxygen concentrations that can even be significantly different from each other.

[0017] The second factor relates to the fact that oxygen is heavier than nitrogen and therefore tends to stratify with respect to nitrogen. This phenomenon therefore increases in practice the effects of the first factor, facilitating the creation of regions with different oxygen concentrations within a same enclosed space.

[0018] The third factor consists in that no environment is perfectly hermetic and nitrogen escapes from the environment to be protected, not only through the necessary and provided openings, for example doors, which every environment necessarily has, but also through cracks, sockets, electrical ducts, gaps and in general through countless other openings which are not intended, not desired and/or not considered both during design and during the practical execution of the environments to be protected.

[0019] This third factor, like the two preceding ones, facilitates the creation of regions having a different residual oxygen gradient.

[0020] DE19934118 discloses a system and apparatus for extinguishing tunnel fires, wherein the tunnel is split into different areas and has separators which in turn have concentration areas forming an inert area. A container holds the inert gas and is situated in the walls of the tunnel, in whose walls inlet openings or other flow apparatus are situated. Separators are formed via mechanical devices.

[0021] The aim of the present invention is to provide a fire-fighting system based on the introduction of inert gas such as nitrogen which overcomes the drawbacks of the cited prior art.

[0022] Within the scope of this aim, an object of the invention is to provide a fire-fighting system which is capable of optimizing the introduction of nitrogen and/or of any inerting gas for the purpose of active fire prevention, within an environment, so as to direct the nitrogen directly where a gap might occur which might allow an outward gas leak.

[0023] Another object of the invention is to provide a fire-fighting system that allows to minimize the introduction of nitrogen or other inert gas that is required to maintain a certain residual oxygen content within an environment and therefore to reduce energy consumption considerably, with respect to the conventional systems known so far and applied to environments of substantial size.

[0024] A further object of the present invention is to provide a fire-fighting system that ensures a constancy and uniformity of the residual oxygen value in the entire volume of the environment to be protected, without the need to install fans or other ventilation equipment, contrary to conventional systems wherein an auxiliary ventilation is required in order to ensure this uniformity.

[0025] A further object of the present invention is to provide a system which, by virtue of its particular constructive characteristics, is capable of giving the greatest assurances of reliability and safety in use.

[0026] A further object of the present invention is to provide a system that can be provided easily by using commonly commercially available elements and materials and is also competitive from an economic standpoint.

[0027] This aim and these and other objects which will become better apparent hereinafter are achieved by a fire-fighting system, comprising a network distributing inert gas into a closed environment through injection points; a plurality of sampling points that take samples of atmosphere in said closed environment in order to measure the quantity of oxygen that is present; an inert gas generator connected to said injection points; an oxygen analyzer connected to said sampling points; said inert gas generator being controlled by said oxygen analyzer so as to send inert gas to the injection points when the oxygen content measured by said sampling points exceeds a preset value; said system being **characterized in that** it comprises a virtual grid which divides said environment into a plurality of regions having variable dimensions: smaller regions at openings of said environment toward the outside, and larger regions where there are no openings; each region comprises at least one injection point and at least one sampling point; said sampling point of each region being distant from the respective injection point.

[0028] Further characteristics and advantages will become better apparent from the description of preferred but not exclusive embodiments of the invention, illustrated by way of non-limiting example in the accompanying drawings, wherein:

Figure 1 is a top view of a closed environment divided by means of a grid, according to the present invention;

Figure 2 is a top view, similar to the preceding one, of the complete fire-fighting system according to the present invention.

[0029] With reference to the cited figures, the fire-fighting system according to the invention is applicable advantageously to a closed environment, generally designated by the reference numeral 1, which is constituted for example by a large environment, on the order of 10,000 m^3 to 500,000 m^3.

[0030] The environment 1 is divided by means of a virtual grid, shown schematically by dashed lines 2 in the figures, which has a variable spacing, i.e., defining regions having different dimensions.

[0031] The grid 2 is used to sensibly arrange the sampling points 4 in order to perform ambient air analyses.

[0032] In particular, the grid has a tighter spacing, i.e., smaller regions, where openings 3 of the environment to be protected are defined, and has a wider spacing, i.e., larger regions, where no openings are provided in the environment.

[0033] The sampling points 4 are arranged at different heights, within each region identified by the grid 2, and are connected to a control unit with an analyzer 12 by means of sampling ducts 13.

[0034] By positioning the sampling points 4 in this manner, the following advantages are achieved.

[0035] The sampling points 4 allow to highlight very precisely, throughout the life of the fire-fighting system, the critical points of the environment 1 to be protected. Accordingly, it is very easy to verify locally, within a large environment, the regions where it is desirable to intervene in order to restore locally the desired level of isolation in the environment 1.

[0036] The grid 2 also allows to arrange an inert gas distribution network that intervenes locally, where the increase in the oxygen level has occurred. Local intervention on the gas leak allows to reduce the quantity of inert gas, that is introduced in the environment 1, to the minimum quantity required in order to restore the local balance at the desired values of residual oxygen.

[0037] The intervention inertia of the preservation system is very small. The fire prevention system in fact does not wait for the oxygen that has entered the environment to propagate and dilute most of the protective atmosphere that is present within the environment, but acts immediately exactly at the point where the problem is occurring, consequently containing the impact of the problem to the region where it has been detected.

[0038] By means of the statistical analysis of the residual oxygen values detected in the sampling points, it is possible to recognize, prevent and correct trends of the prevention system that might lead, in the best case, to energy waste due to excessive injection of inerting gas within the system with respect to what is actually required in order to keep the system under control and might cause, in the worst case, the environment to leave the safety zone.

[0039] The system according to the invention also comprises a network for the distribution of the protective gas which allows to uniformly distribute the gas within the environment volume.

[0040] In particular, the inerting gas is distributed by means of a distribution network which comprises T members 5 which are mutually connected and are fed by a central nitrogen generation unit 9 which is connected to the T members by means of feed pipes 11.

[0041] Each T member has injection points 6 which are controlled by automatic valves 7, driven by the analysis and monitoring software of the prevention system.

[0042] A characteristic of this distribution system is that the gas injection points 6 are distributed on a matrix, like the residual environment oxygen sampling points 4, but are offset with respect to the sampling points, in order to prevent a short-circuiting between the analysis of the residual oxygen and the introduction of inert gas/nitrogen, which would hide the actual severity and diffusion of an isolation problem of the environment to be protected.

[0043] The benefits of this system for the distribution of inerting gas in an environment are several.

[0044] The distribution system according to the present invention optimizes the quantity of inert gas that is introduced in the environment, which is conveyed only where it is actually necessary, therefore reducing its consumption.

[0045] The system therefore reduces the energy consumption required to keep the environment 1 safe.

[0046] The system also allows a reduction of the gradients of the different values of residual oxygen within the environment and a greater uniformity of the residual oxygen value, to be maintained within the environment, ensuring that regions with oxygen values out of control and/or out of the safe zone are not present within the environment.

[0047] Preferably, an inert gas lighter than air is used, for example nitrogen, and the distribution system is provided at zero height; i.e., at the level of the floor of the environment to be protected.

[0048] This improves the mixing of the inert gas with the oxygen that is present within the enclosed space to be protected, which stratifies if it is heavier than the introduced inert gas.

[0049] In this manner, once again the possibility of having regions with different oxygen values is reduced, with the consequent benefits listed above.

[0050] A further characteristic of the present invention is that part of the mixture, that is present within the environment 1, is drawn directly from the partitioning regions dedicated to the operating intakes 3 and is then reused, mixed with the external air, in the nitrogen generators in order to improve their efficiency.

[0051] In practice, the environment 1 has mainly two types of openings: safety doors-openings 3, which are intended indeed for the safe evacuation of people in case of emergency, and "work door" openings, designated by the reference numeral 33, which are intended for normal access to the structure and through which people and goods normally pass (Figure 1).

[0052] In these environments the differentiation is not only theoretical, but has an important practical consequence.

[0053] While it is assumed that safety doors 3 must be used only rarely in case of a real emergency, and therefore in case of opening it is not necessary to control/minimize the inflow of oxygen from outside, in the case of work openings 33 it is in fact assumed that they are operated even several times per day. Hence the need to partition the normal axis regions by using a double door which defines an antechamber 8.

[0054] The double door system reduces the inflow of oxygen into the environment to be protected.

[0055] By sampling gas from the partitioned region 8, a slight negative pressure is created in the region which attracts air both from the outside and from the inside of the environment to be protected.

[0056] By suitably designing the natural openings of the partitioned region it is possible to create dynamically, during the ordinary operation of the system, a partitioned region that has a clearly defined residual oxygen content, the value of which can be designed so as to be as close as one wishes to the content that is present outside the environment to be protected, approximately 20.9%, or to the value that is present within the environment 1 to be protected, for example 15%.

[0057] This refinement improves the efficiency of nitrogen generators by approximately 30%. In practice, the nitrogen generators generate an oxygen-poor gas mix, which therefore is nitrogen-rich, starting from a gas mix that already initially has a lower oxygen level than the ambient atmosphere.

[0058] Another advantage of this system is the improvement of the efficiency of the partitioned region, as a barrier to the inflow of oxygen into the environment to be protected, during the normal operation and life of the system.

[0059] Both of these benefits cooperate to improve the efficiency of the system and to reduce significantly its energy demand.

[0060] In practice it has been found that the invention achieves the intended aim and objects, a firefighting system having been provided which is absolutely effective and capable of reducing energy consumption.

[0061] The installation of the system according to the present invention is also substantially more economic than the installation of a traditional water-based system (sprinklers).

[0062] This application claims the priority of Italian Patent Application No. MI2011A000686, filed on April 21, 2011, the subject matter of which is incorporated herein by reference.

Claims

1. A fire-fighting system, comprising a network distributing inert gas into a closed environment (1) through injection points (6); a plurality of sampling points (4) that take samples of atmosphere in said closed environment (1) in order to measure the quantity of oxygen that is present; an inert gas generator (9) connected to said injection points (6); an oxygen analyzer (12) connected to said sampling points (4); said inert gas generator (9) being controlled by said oxygen analyzer (12) so as to send inert gas to the

injection points (6) when the oxygen content measured by said sampling points (4) exceeds a preset value; said system being **characterized in that** it comprises a virtual grid (2) which divides said environment (1) into a plurality of regions having variable dimensions: smaller regions at openings (3, 33) of said environment toward the outside, and larger regions where there are no openings; each region comprises at least one injection point (6) and at least one sampling point (4); said sampling point (4) of each region being distant from the respective injection point (6).

2. The system according to claim 1, **characterized in that** said injection point (6) in each of said regions is arranged substantially at the level of the floor of said environment (1).

3. The system according to claim 1, **characterized in that** said sampling points (4) are arranged at different heights, within each one of said regions, and are connected to a control unit with an analyzer (12) by means of sampling ducts (13).

4. The system according to claim 1, **characterized in that** said gas distribution network comprises T members (5) which are mutually connected and are fed by said inert gas generator (9); said inert gas generator (9) being connected to said T members (5) by means of feed pipes (11); each T member (5) has said injection points (6) controlled by automatic valves (7).

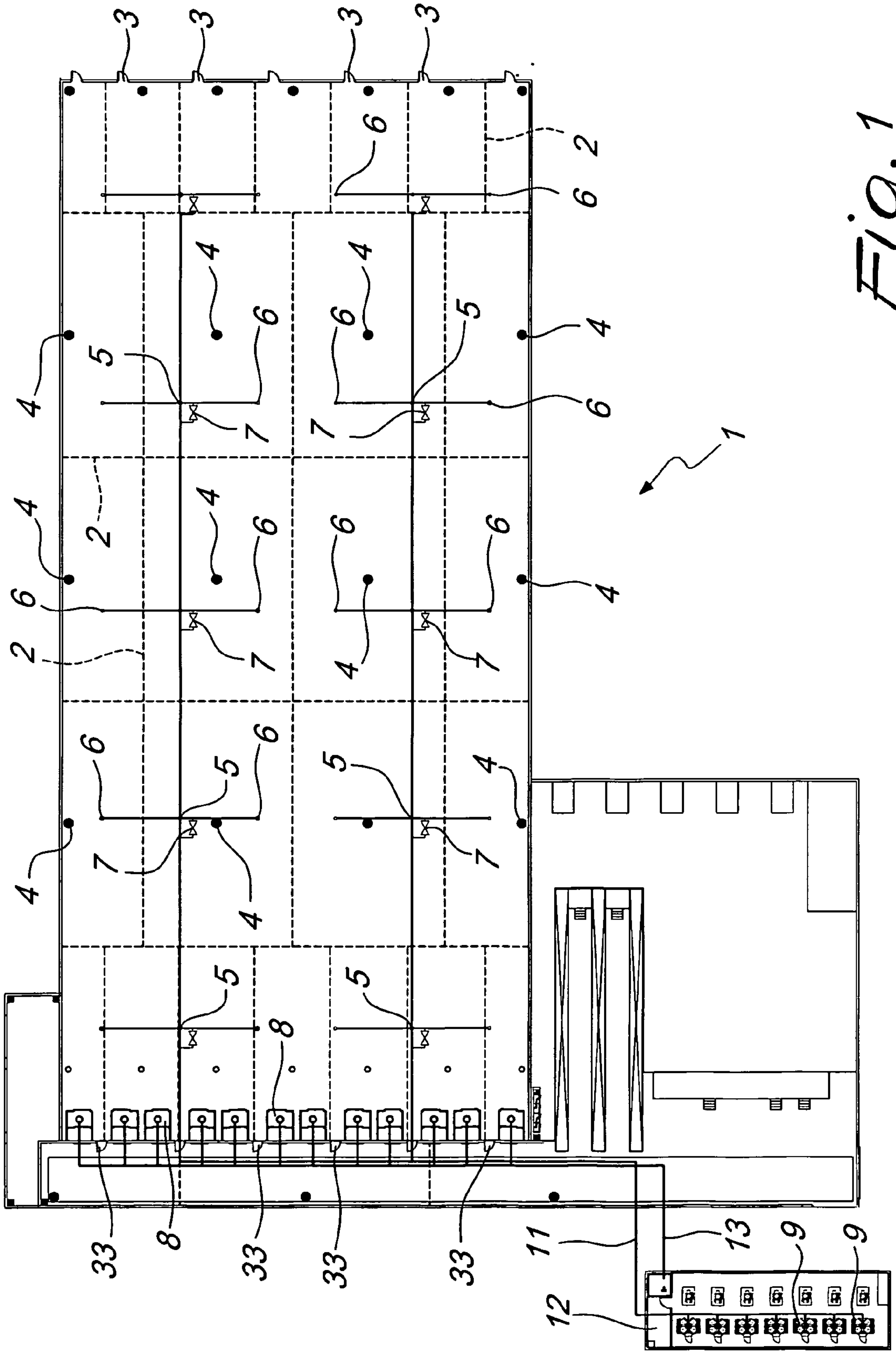

Fig. 1

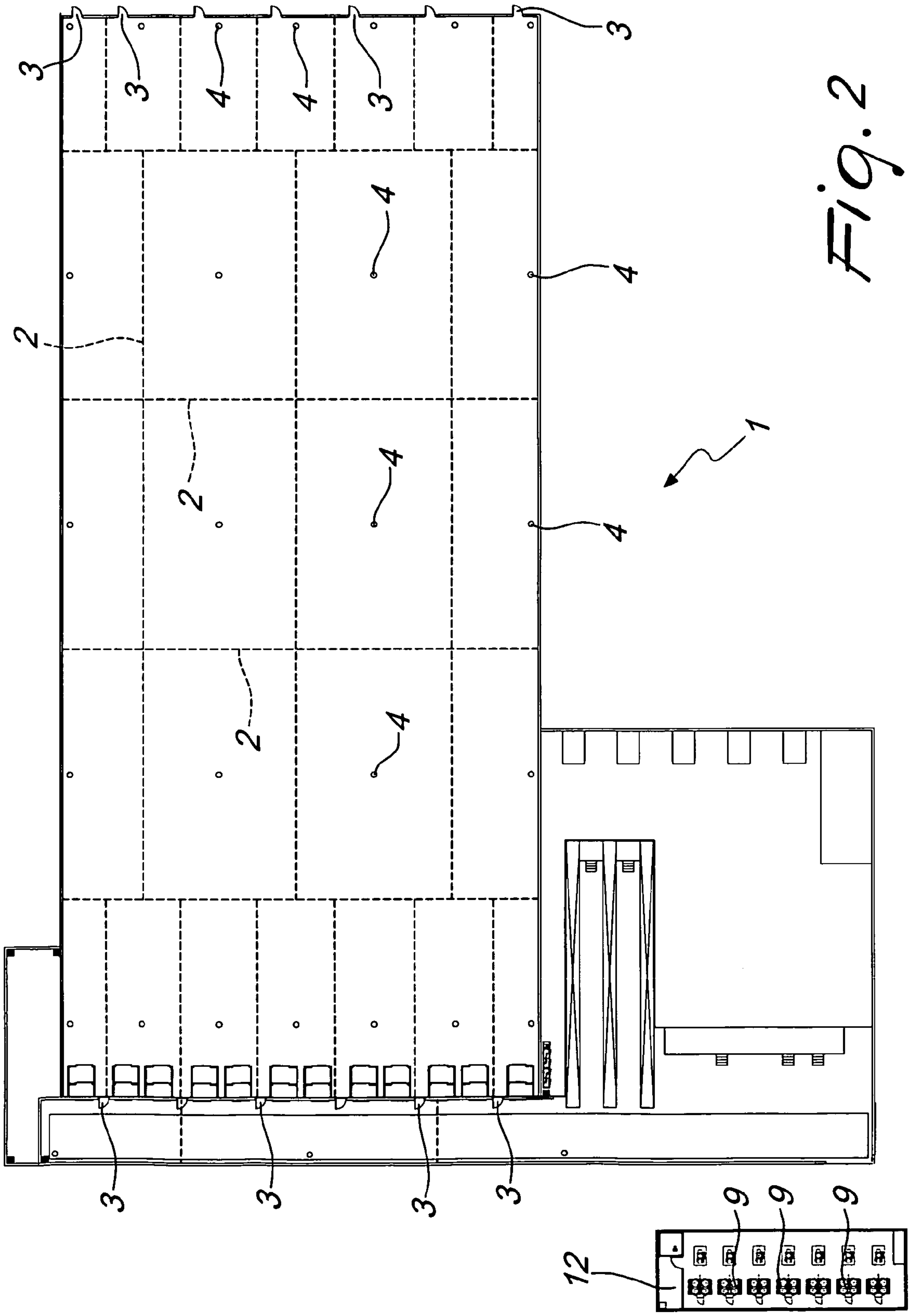

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 12 00 2762

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	DE 199 34 118 A1 (WAGNER ALARM SICHERUNG [DE]) 1 February 2001 (2001-02-01) * abstract; figures * -----	1	INV. A62C37/40
A	US 2003/058114 A1 (MILLER MARK S [US] ET AL) 27 March 2003 (2003-03-27) * figure 1 * -----	1	
A	CH 572 752 A5 (CERBERUS AG) 27 February 1976 (1976-02-27) * figures 1,2 * -----	1	
A	WO 03/056325 A1 (WAGNER ALARM SICHERUNG [DE]; WAGNER ERNST WERNER [DE]) 10 July 2003 (2003-07-10) * abstract; figures * -----	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			A62C

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	8 October 2012	Nehrdich, Martin

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 12 00 2762

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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08-10-2012

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE 19934118 A1	01-02-2001	NONE	
US 2003058114 A1	27-03-2003	EP 1428190 A1	16-06-2004
		US 2003058114 A1	27-03-2003
		WO 03027980 A1	03-04-2003
CH 572752 A5	27-02-1976	AU 8673475 A	26-05-1977
		CH 572752 A5	27-02-1976
		DE 2548850 A1	24-06-1976
		GB 1474680 A	25-05-1977
		JP 1035199 C	26-02-1981
		JP 51122997 A	27-10-1976
		JP 55026869 B	16-07-1980
WO 03056325 A1	10-07-2003	AT 327505 T	15-06-2006
		AU 2002358476 A1	15-07-2003
		CA 2471959 A1	10-07-2003
		CN 1596370 A	16-03-2005
		DE 10164293 A1	10-07-2003
		DK 1459062 T3	14-08-2006
		EP 1459062 A1	22-09-2004
		ES 2262881 T3	01-12-2006
		PT 1459062 E	29-09-2006
		US 2005155407 A1	21-07-2005
		WO 03056325 A1	10-07-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- DE 19934118 **[0020]**
- IT MI20110686 A **[0062]**