(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 950 715 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
30.07.2008 Bulletin 2008/31

(51) Int Cl.:
G07F 19/00 *(2006.01)* ***B65D 90/22*** *(2006.01)*

(21) Application number: **07076117.6**

(22) Date of filing: **20.12.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

(30) Priority: **20.12.2006 NL 1033093**

(71) Applicant: **ASR Holding B.V.**
6666 LV Heteren (NL)

(72) Inventor: **Rots, Antonius Bernardus**
6523 MX Nijmegen (NL)

(74) Representative: **Bartelds, Erik et al**
Arnold & Siedsma
Sweelinckplein 1
2517 GK The Hague (NL)

(54) Method and device for securing a space against danger of gas explosion

(57) The invention relates to a method for securing a space against danger of gas explosion, comprising of detecting the composition of the atmosphere in the space and generating a warning signal when the detected composition becomes explosive, wherein an explosion-inhibiting agent is introduced into the space when the warning signal is generated.

The explosion-inhibiting agent, which can bind potentially explosive elements in the atmosphere in the space, can be introduced into the space in the form of an aerosol which can be formed by chemical decomposition of a solid present in or close to the space.

Additionally or instead, it is possible to envisage the atmosphere in the space being detonated when the warning signal is generated.

The invention further relates to a security device for performing this method.

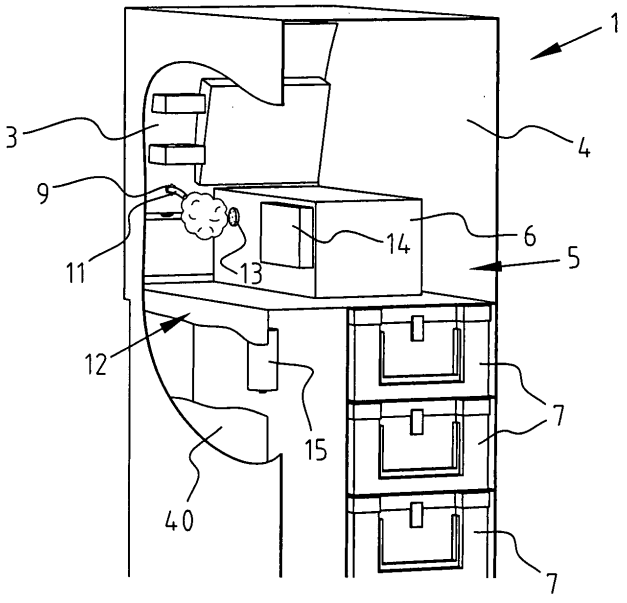

FIG. 2

EP 1 950 715 A2

Description

[0001] The invention relates to a method for securing a space against danger of gas explosion, comprising of detecting the composition of the atmosphere in the space and generating a warning signal when the detected composition becomes explosive. Such a method is known and is applied for instance for monitoring spaces in which explosive substances are used. The present invention relates particularly to the securing of secure compartments of cash dispensers, deposit safes and the like against the danger of a gas explosion.

[0002] Cash dispensers or deposit safes are generally built into frontages of bank premises. By the nature of their function they are readily accessible and therefore difficult to safeguard. In recent times cash dispensers in particular are being robbed increasingly more often in so-called gas attacks. Using flammable gas or gas mixture and explosives criminals blow a complete cash dispenser out of the wall. For this purpose a hole is made in the cash dispenser, usually in the vicinity of the dispensing opening where the money comes out. A flammable gas or gas mixture is then pumped inside through this hole using a hose. This gas or gas mixture is then caused to explode from a distance with a small explosive or only a detonator, after which the secure compartment of the cash dispenser is opened.

[0003] This type of attack results in considerable economic damage. In addition to the loss of the cash supply present in the secure compartment, the damage to the building into which the cash dispenser has been built is often very great. In addition, there is a considerable risk of personal injury both to the thieves themselves and to possible chance passers-by.

[0004] Attempts have already been made to prevent this type of attack, for instance by installing permanent video monitoring at cash dispensers, deposit safes and similar installations with a secure compartment. This has only a limited deterrent effect however, because criminals know that the response time of police or security firms, particularly during the evening and at night, is often relatively long.

[0005] It has also been proposed to modify secure compartments structurally in order to make a gas explosion impossible or to be able to withstand such an explosion. In the former case it is possible to envisage embodying the secure compartment in relatively "open" form, optionally in combination with a system of permanent ventilation, thereby preventing injected gases or gas mixtures from ever reaching an explosive concentration. An "open" embodiment of a secure compartment does not however combine well with the desired security against other forms of theft. In order to be able to withstand the consequences of a gas explosion, a secure compartment has to be built in and embodied in a manner wholly different from that which has been usual heretofore. As with the "open" embodiment, this requires considerable and costly modifications which are often not possible in practice in the case of existing cash dispensers and deposit safes.

[0006] The invention therefore has for its object to further develop a method of the type described in the preamble such that spaces, and in particular secure compartments, can thereby be secured against danger of gas explosion resulting from the above described criminal practices, without major costly modifications being necessary for this purpose. According to a first aspect of the invention, this is achieved in such a method in that an explosion-inhibiting agent is introduced into the space when the warning signal is generated. A gas explosion can be efficiently prevented by introducing an explosion inhibitor in this way immediately a potentially explosive concentration of a determined substance is detected in the secured space. The detection of explosion hazard and the introduction of an explosion inhibitor can moreover be realized with relatively simple means, even in existing secure compartments.

[0007] The explosion-inhibiting agent is preferably introduced into the space in the form of an aerosol. The explosion-inhibiting agent can thus fill the whole space to be secured in a short time.

[0008] When the aerosol is formed by chemical decomposition of a solid present in or close to the space, it is possible to suffice with a relatively small quantity of solid which can be easily accommodated in or close to the space to be secured. The chemical decomposition can advantageously then be initiated and sustained here by the warning signal. The forming of the aerosol can thus also be continued without an outside heat supply.

[0009] The explosion-inhibiting agent preferably binds the potentially explosive elements in the atmosphere in the space. This prevents them from exploding. The explosion-inhibiting agent can optionally also have a cooling action, thereby reducing the explosion hazard still further.

[0010] When the explosion-inhibiting agent is introduced into the space in a number of doses, wherein a wait time is taken into account between the introduction of each successive dose, it is possible to prevent the explosion-inhibiting agent nevertheless being displaced by explosive mixture injected later.

[0011] According to a second aspect of the invention, the method is distinguished in that the atmosphere in the space is detonated when the warning signal is generated. By thus as it were prematurely detonating the possibly explosive atmosphere the gas explosion is kept limited, whereby it does not result in damage, or hardly so.

[0012] This detonation can also be combined with the introduction of the explosion-inhibiting agent. In this case the explosion-inhibiting agent can for instance be introduced first, and then - if the criminals continue to inject explosive gases into the space, whereby the explosion-inhibiting agent could be displaced - the explosive gases are detonated before they reach a concentration such that an explosion would have serious consequences.

[0013] In order to reduce the risk of a hazardous situ-

ation nevertheless occurring after the introduction of the explosion-inhibiting agent due to continued feed of explosive gases, detonation of the atmosphere in the space is preferably repeated periodically.

[0014] For an optimum security against danger of gas explosion it is recommended that the composition of the atmosphere is detected at different locations in or close to the space.

[0015] So as to be already alerted at an early stage to possible injection of an explosive mixture, it is recommended that the integrity of the space is also monitored, and a warning signal is generated when this is impaired. A warning can thus already be generated if a hole is being drilled through which the explosive mixture will be injected.

[0016] The invention also relates to a device for performing the above described method. Devices are already known for securing a space against danger of gas explosion, which are provided with means for detecting the composition of the atmosphere in the space and means connected to the detecting means for generating a warning signal when the detected composition becomes explosive. The security device according to the present invention is distinguished from these known devices by means connected controllably to the warning signal-generating means for introducing an explosion-inhibiting agent into the space.

[0017] The explosion inhibitor-introducing means are preferably adapted to introduce an aerosol into the space, and advantageously comprise for this purpose a solid which is present in or close to the space and which can be converted by chemical decomposition into an aerosol. A structurally simple and effective security device is then obtained when the explosion inhibitor-introducing means comprise at least one container which is filled with the solid and which comprises an initiator connected to the warning signal-generating means.

[0018] The explosion inhibitor-introducing means preferably comprise a plurality of containers filled with the solid, and the warning signal-generating means comprise a delaying element for each container. The individual containers can thus be activated at different points in time after the warning signal has been generated, whereby the explosion-inhibiting agent is dispensed in a number of separate doses. It is hereby possible to prevent the initially formed aerosol being displaced by explosive gas that is injected later.

[0019] As already stated above, the explosion-inhibiting agent is advantageously adapted to bind potentially explosive elements in the atmosphere in the space.

[0020] The security device according to the invention can additionally or instead be distinguished from known devices by means connected controllably to the warning signal-generating means for the purpose of detonating the atmosphere in the space. These detonating means are preferably periodically active after receiving the warning signal.

[0021] The detecting means advantageously comprise at least one gas sensor placed in or close to the space. Gas sensors are widely available commercially and in many variants. In addition to a high sensitivity, a rapid response time of the gas sensor is particularly important in the present application. For optimum security it is otherwise recommended that the detecting means comprise a plurality of gas sensors placed at different locations in or close to the space.

[0022] As already stated above, the security device can advantageously be provided with means connected for signal generation to the warning signal-generating means for the purpose of monitoring the integrity of the space. These monitoring means can for instance comprise a drilling detector or a seismic vibration sensor.

[0023] The warning signal-generating means preferably form part of an electronic control system comprising at least one input connected to the detecting means and at least one output connected to the explosion inhibitor-introducing means. Further functions of the security device can be incorporated in this control system, for instance relating to monitoring of the operation of the device, the lifespan of the components used or the maintenance thereof.

[0024] The invention will now be elucidated on the basis of an embodiment, wherein references made to the accompanying drawing, in which:

Fig. 1 shows a schematic perspective view of a cash dispenser during an attempted gas attack,

Fig. 2 shows a view of the interior of the cash dispenser as according to arrow II in fig. 1,

Fig. 3A, 3B and 3C show schematic side views of a container with solid from which an explosion-inhibiting aerosol is formed, and

Fig. 4 shows a block diagram of a control system with different inputs and outputs.

[0025] A cash dispenser 1 (fig. 1) comprises a control panel 3 arranged in an outer wall 2 of a building and internal parts 5 placed in a reinforced space 4 in the building. These internal parts 5 comprise the actual dispensing machine 6 and a secure compartment or safe 40 with a number of cash cassettes 7 therein.

[0026] As stated above, cash dispenser 1 is liable to attacks and vandalism as a result of its readily accessible location. The most recent form of attack is the so-called gas attack. A hole 9 is here made in cash dispenser 1 using a drill 8. Using a hose 11 a flammable gas or gas mixture G is then pumped inside through this hole 9 from a gas bottle 10. This gas or gas mixture G is then made to explode from a distance using a small explosive or just a detonator, after which cash dispenser 1 is blown out of the wall 2, or at least the secure compartment 40 thereof is blown open.

[0027] In order to prevent this type of attack the cash dispenser 1 according to the invention is provided with a safety device 12 (fig. 2). This comprises in the first place means 13 for detecting the composition of the atmos-

phere in space 4, for instance in the form of one or more gas sensors (only one shown) arranged in space 4 itself or in the immediate vicinity thereof. Gas sensors 13 can be highly sensitive industrial sensors for use in high-risk environments, as for instance known in the offshore industry. In order to keep the response time of these gas sensors 13 as short as possible, the many types of filter normally used to prevent false alarms can be removed. In the shown embodiment so-called catalytic gas sensors are applied in which use is made of a thermal measurement principle.

[0028] In addition to sensors which detect the presence of a possibly explosive gas mixture, use can also be made of sensors which compare the composition of the atmosphere in space 4 to a standard atmosphere, generally air. An oxygen sensor (not shown here) can for instance be used for this purpose which generates a signal when the oxygen concentration in space 4 clearly deviates from 21%, the value in the standard atmosphere.

[0029] In addition, security device 12 comprises means 14 connected to detecting means 13 for the purpose of generating a warning signal when the detected composition becomes explosive. In the shown embodiment these warning signal-generating means 14 form part of an electronic control system which will be elucidated in more detail below.

[0030] Finally, security device 12 comprises means 15 connected controllably to the warning signal-generating means 14 for the purpose of introducing an explosion-inhibiting agent into space 4. Applied in the shown embodiment as explosion-inhibiting agent is an aerosol A which binds potentially explosive elements in the atmosphere in space 4. This aerosol must meet several requirements. It must thus be a means which is not harmful to humans and animals, the environment, the ozone layer or the materials used in cash dispenser 1. In addition, the aerosol may not remove oxygen so as to avoid suffocation hazard.

[0031] The explosion inhibitor-introducing means 15 comprise at least one container 16 filled with a solid 17 which can be converted into the aerosol by chemical decomposition. An initiator 18 which is connected to the warning signal-generating means 14 and which initiates and sustains the decomposition reaction of solid 17 is accommodated in this container 16 (fig. 3A). Although only a single container 16 is shown here, it will be apparent that a plurality of containers can be arranged distributed in and round space 4. Container 16 is provided on one side with a weighted base 36 and further has a strengthened side wall 37 and a cover 38 which collapses readily, thereby enabling a targeted delivery of the aerosol. A chemical cooling agent 39 is arranged in container 16 between solid 17 and cover 38, whereby heat created during the decomposition of solid 17 into aerosol is absorbed (fig. 3B). This cooling agent 39 is likewise decomposed here and remains behind in container 16 (fig. 3C). The aerosol can thus leave container 16 at relatively low temperature, and the aerosol itself does not form a detonation source for the potentially explosive gas mixture in space 4.

[0032] Although only a single container 16 is shown in the example, a plurality of containers 16 can be applied in practice which can be arranged at different locations in space 4, at dispensing machine 6 as well as at secure compartment 40. Initiators 18 of these containers can then be energized at different points in time after the first warning signal has been generated, whereby a cascade of aerosol discharges as it were takes place.

[0033] In addition to gas sensors 13, security device 12 can also be provided with means (not shown) for monitoring the integrity of space 4. These monitoring means, which are likewise connected for signal generation to warning signal-generating means 14, can for instance comprise a drilling detector or a seismic vibration sensor.

[0034] The signals from the different sensors and/or detectors are converted by the warning signal-generating means 14 into one or more warning or alarm signals. These warning signals serve not only to activate the explosion inhibitor-introducing means 15, but can also be used for instance to alert a control room or to activate an alarm system.

[0035] As stated, the warning signal-generating means 14 form part of an electronic control system 19 (fig. 4), which in the shown embodiment has eight inputs I1-I8 and eight outputs O1-O8. Of the eight inputs I1-I8 four are analog inputs I1-I4 connected to detecting means 13, more particularly the gas sensors. In the shown embodiment these analog inputs I1-I4 have a measuring range of 0 to 5 V. In addition, there are two digital alarm inputs I5, I6 and two digital switch inputs I7, I8 for the purpose of switching security device 12 on and off, for instance for maintenance purposes.

[0036] The eight outputs O1-O8 are divided into six alarm outputs 01-06, an error output 07 and a maintenance output 08. Of the six alarm outputs O1-O6, embodied as open collector, at least one O1 is connected to the explosion inhibitor-introducing means 15. When more than one container 16 is used, a plurality of alarm outputs, for instance also outputs 05 and 06 can also be connected to the different containers 16. The remaining alarm outputs 02-04 are intended to generate warning signals to other equipment, such as for instance an alarm installation at the location of cash dispenser 1 and an alarm dialer which can transmit the warning signal to a central control room. One of the alarm outputs I can also be connected to a detonator placed in space 4 which detonates the already injected gas mixture before it can reach a dangerous concentration.

[0037] Finally, the electronic control system 19 also comprises on the input side a further two RS-232 ports 20, 21, an I2C bus 22, an SPI bus 23, two terminals 24, 25 for programming and/or updating firmware and a 24 V power connection 26. On the output side the electronic control system 19 is further provided with five LED outputs L1-L5 and a buzzer output 27.

[0038] The electronic control system 19 comprises different circuits and memories. There is thus a circuit 28 for updating firmware, a self-test circuit 29, a circuit 30 in which the serial number of security device 12 is included, an I2C circuit 31, an erasable programmable read-only memory (EEPROM) 32, a clock circuit 33, a circuit 34 for tracking use and an RS-232 communication circuit 35. I2C circuit 31 is here a bus with which security device 12 can be coupled to other systems, for instance a system with which in the case of an attack a dye is sprayed onto the banknotes in the cash dispenser ("Ink & Dye"). Via this bus the memory of electronic control system 19 can also be extended or a display can be connected to the system.

[0039] The six alarm inputs I1-I6 can be configured such that they can generate a warning signal at one or more of the six alarm outputs O1-O6. Alarm inputs I1-I6 can each be switched off individually.

[0040] As stated, the gas sensors used are catalytic sensors which perform a thermal measurement. When device 12 is switched on, such sensors have a warm-up time in the order of a minute. During this warm-up time the sensor generates a current of about 2 mA. The same current is generated in the case the sensor fails. Under normal conditions of use the sensor generates a measurement value varying between 4 and 20 mA. A current of 4 mA represents the rest state and corresponds to a concentration of potential explosive gas of 0% LEL (Lower Explosive Level, the lowest concentration at which the gas can form an explosive mixture). A current of 20 mA corresponds to a concentration of 100% LEL, this meaning that a concentration has been reached at which a gas explosion is possible. Security device 12 must of course take action before this value is reached.

[0041] As soon as one or more of the gas sensors senses the presence of a potentially explosive gas above an adjustable level, and thus generates a current of more than 4 mA at its associated input I, one or more alarm outputs O are actuated. The input signal of the gas sensor can herein optionally be transmitted with an adjustable delay, whereby the explosion-inhibiting agent can be introduced at intervals from different containers 16 into space 4. The delay can also serve to first introduce the explosion-inhibiting agent, and to begin some time later to detonate the gas mixture then injected again before it reaches a dangerous concentration. A gas sensor can thus actuate a plurality of alarm outputs 01-06, each with its own delay.

[0042] These outputs 01-06 can respond in different ways to an alarm. A first option is that output 0 is set when the alarm value is reached at one of the selected inputs I, and is once again reset when the value at input I again falls below the set alarm value. A small measure of hysteresis, for instance in the order of 10%, can then be applied here in order to prevent oscillation. Another option is that output 0 generates an adjustable pulse as soon as the alarm value is reached. The pulse duration of this adjustable pulse can vary between 0 and 9999 seconds. It is the case for both the first and the second option that an adjustable delay of 0 to 9999 seconds can be applied before output 0 is actually actuated when an alarm value is reached at input I. Finally, the LED output L4 is also energized in the case of an alarm.

[0043] As soon as security device 12 is switched off via input I8 ("alarm on/off"), alarm outputs 01-06 are all reset again and the signal is also removed from LED output L3. This is also the case when a door which gives access to space 4 is opened. Input 17 is connected for this purpose to a door contact.

[0044] The six alarm outputs O1-O6 are otherwise so-called "monitored" outputs. When no load is detected at outputs 01-06, this then results in an error signal at error output 07. In addition the LED output L1 is then energized, whereby an error-indicating LED lights up, and an acoustic error signal is generated via buzzer output 27. Error output 07 further generates an error signal if there is a voltage of 0.75 V or lower at one or more of the four analog inputs I1-I4. This monitoring of errors can be activated and deactivated individually for each input I and output O.

[0045] Electronic control 19 is adapted such that security device 12 cannot be switched on when one or more sensors have failed or indicate an alarm value. The audible and visible indication of an error by means of buzzer output 27 and LED output L1 otherwise continue to operate when security device 12 is not switched on, for instance when the door has been opened, in order to give the service engineer a clear indication.

[0046] The final output 08 is a maintenance output which switches as soon as an adjustable maintenance interval has lapsed. LED output L2 is then also energized. Each analog input I1-I4 has a maintenance counter which begins to count as soon as a sensor is connected thereto, at least when input voltage U_{in} becomes greater than 0.75 V. The maintenance counters have a resolution of a day and can count 9999 days. Maintenance output 08 is activated as soon as one or more of these counters reaches the set maintenance interval. The underlying idea is that a gas sensor only has a determined lifespan and must be replaced in good time in order to ensure the operation of the security device. The counter values can be read and reset by a command via RS-232 port 20, 21. Electronic control 19 can otherwise be restored integrally to the factory settings by means of a jumper on the printed circuit board.

[0047] In the above described manner and using the security device described and shown here a space, more particularly a space in which a cash dispenser is situated, can thus be efficiently safeguarded against gas explosions. Although the invention is described above on the basis of an embodiment, it will be apparent that it is not limited thereto and can be varied in many ways within the scope of the following claims.

Claims

1. Method for securing a space against danger of gas explosion, comprising of detecting the composition of the atmosphere in the space and generating a warning signal when the detected composition becomes explosive, **characterized in that** an explosion-inhibiting agent is introduced into the space when the warning signal is generated.

2. Method as claimed in claim 1, **characterized in that** the explosion-inhibiting agent is introduced into the space in the form of an aerosol.

3. Method as claimed in claim 2, **characterized in that** the aerosol is formed by chemical decomposition of a solid present in or close to the space.

4. Method as claimed in claim 3, **characterized in that** the chemical decomposition is initiated and sustained by the warning signal.

5. Method as claimed in any of the foregoing claims, **characterized in that** the explosion-inhibiting agent binds potentially explosive elements in the atmosphere in the space.

6. Method as claimed in any of the foregoing claims, **characterized in that** the explosion-inhibiting agent is introduced into the space in a number of doses, wherein a wait time is taken into account between the introduction of each successive dose.

7. Method as claimed in any of the foregoing claims or according to the preamble of claim 1, **characterized in that** the atmosphere in the space is detonated when the warning signal is generated.

8. Method as claimed in claim 7, **characterized in that** the detonation of the atmosphere in the space is repeated periodically.

9. Method as claimed in any of the foregoing claims, **characterized in that** the composition of the atmosphere is detected at different locations in or close to the space.

10. Method as claimed in any of the foregoing claims, **characterized in that** the integrity of the space is also monitored, and a warning signal is generated when this is impaired.

11. Device for securing a space against danger of gas explosion, comprising means for detecting the composition of the atmosphere in the space and means connected to the detecting means for generating a warning signal when the detected composition becomes explosive, **characterized by** means connected controllably to the warning signal-generating means for introducing an explosion-inhibiting agent into the space.

12. Security device as claimed in claim 11, **characterized in that** the explosion inhibitor-introducing means are adapted to introduce an aerosol into the space.

13. Security device as claimed in claim 12, **characterized in that** the explosion inhibitor-introducing means comprise a solid which is present in or close to the space and which can be converted by chemical decomposition into an aerosol.

14. Security device as claimed in claim 13, **characterized in that** the explosion inhibitor-introducing means comprise at least one container which is filled with the solid and which comprises an initiator connected to the warning signal-generating means.

15. Security device as claimed in any of the claims 11-14, **characterized in that** the explosion inhibitor-introducing means comprise a plurality of containers filled with the solid, and the warning signal-generating means comprise a delaying element for each container.

16. Security device as claimed in any of the claims 11-15, **characterized in that** the explosion-inhibiting agent is adapted to bind potentially explosive elements in the atmosphere in the space.

17. Security device as claimed in any of the claims 11-16 or according to the preamble of claim 11, **characterized by** means connected controllably to the warning signal-generating means for the purpose of detonating the atmosphere in the space.

18. Security device as claimed in claim 17, **characterized in that** the detonating means are periodically active after receiving the warning signal.

19. Security device as claimed in any of the claims 11-18, **characterized in that** the detecting means comprise at least one gas sensor placed in or close to the space.

20. Security device as claimed in claim 19, **characterized in that** the detecting means comprise a plurality of gas sensors placed at different locations in or close to the space.

21. Security device as claimed in any of the claims 11-20, **characterized by** means connected for signal generation to the warning signal-generating means for the purpose of monitoring the integrity of the space.

22. Security device as claimed in any of the claims 11-21, **characterized in that** the warning signal-generating means form part of an electronic control system comprising at least one input connected to the detecting means and at least one output connected to the explosion inhibitor-introducing means.

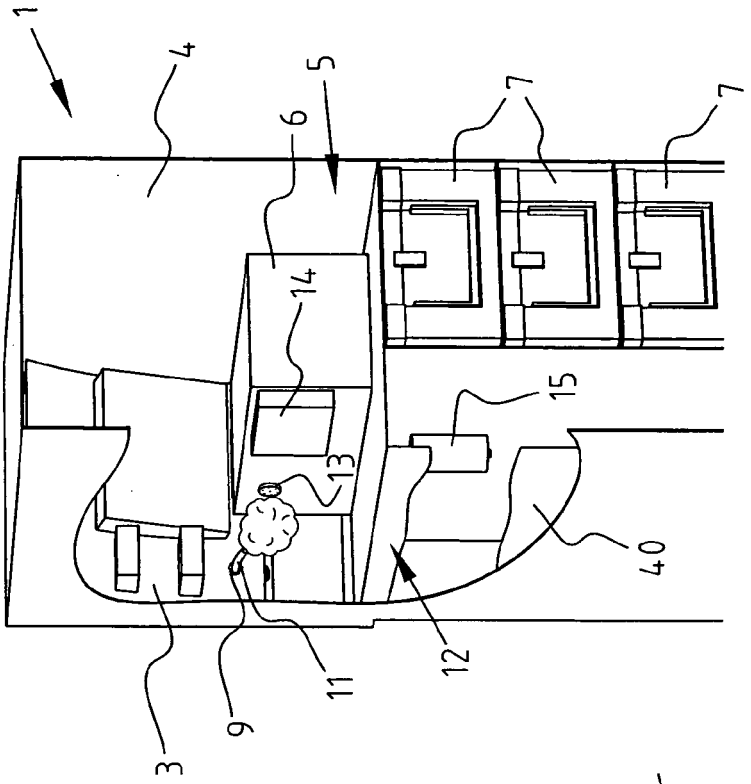

FIG. 2

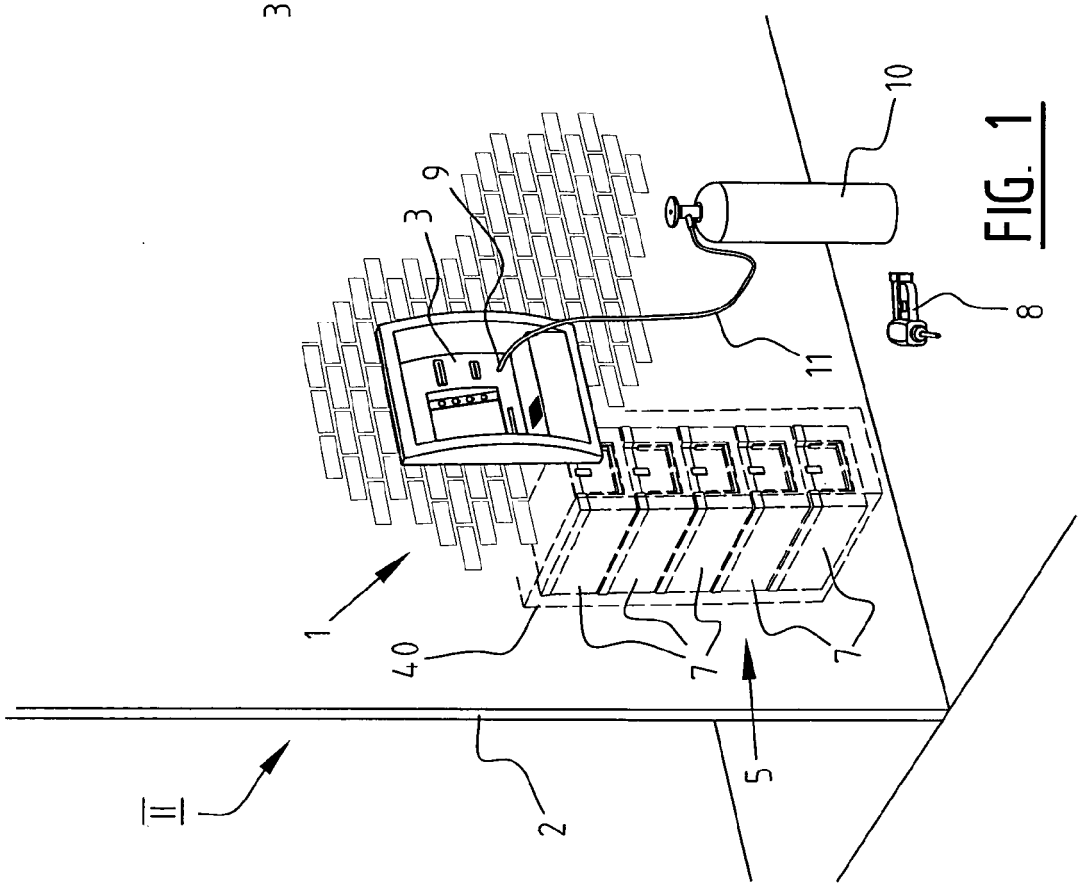

FIG. 1

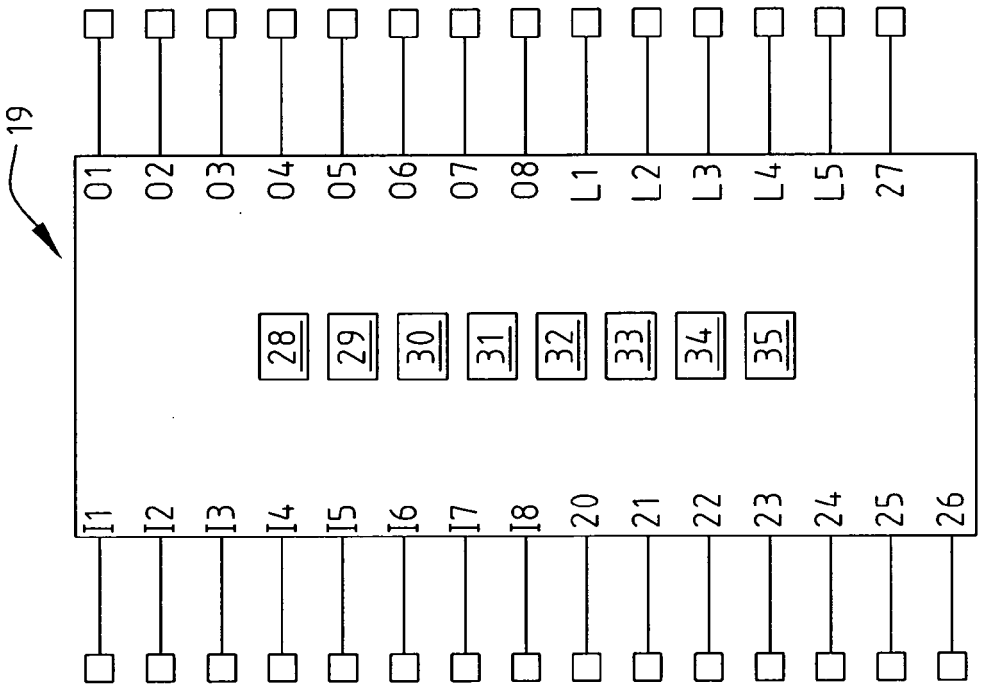

FIG. 4

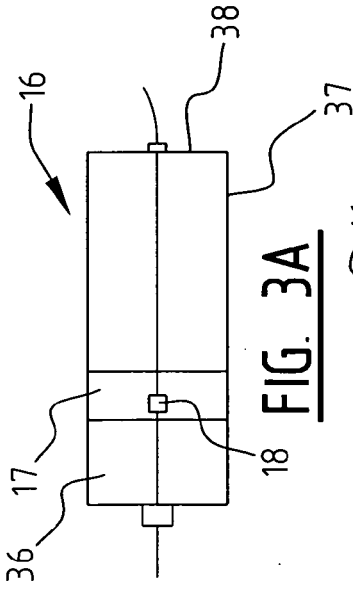

FIG. 3A

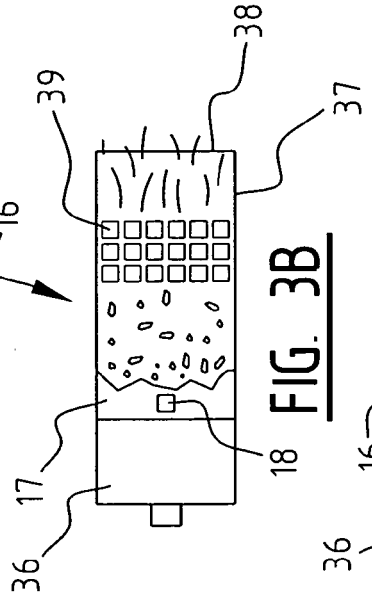

FIG. 3B

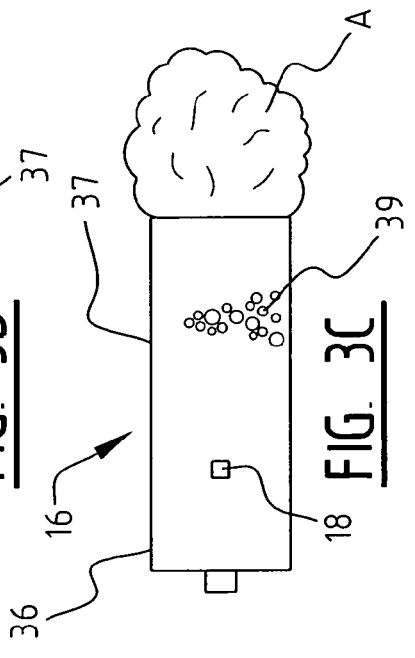

FIG. 3C