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(54) Motor vehicle security device.

(57) A Vehicle Defense or Security System (VDS) which, once triggered, generates enough smoke to completely engulf the interior of a protected vehicle. The smoke attracts attention to the vehicle and visually impairs would be thieves from seeing valuables inside the vehicle. VDS can be used as an add-on to existing alarms or as a stand-alone defense system. The smoke generated is non-toxic and harmless to humans and the interior of the vehicle. This system provides a unique, effective defense or security system which is silent to eliminate annoying false alarm sirens, horns or the like.

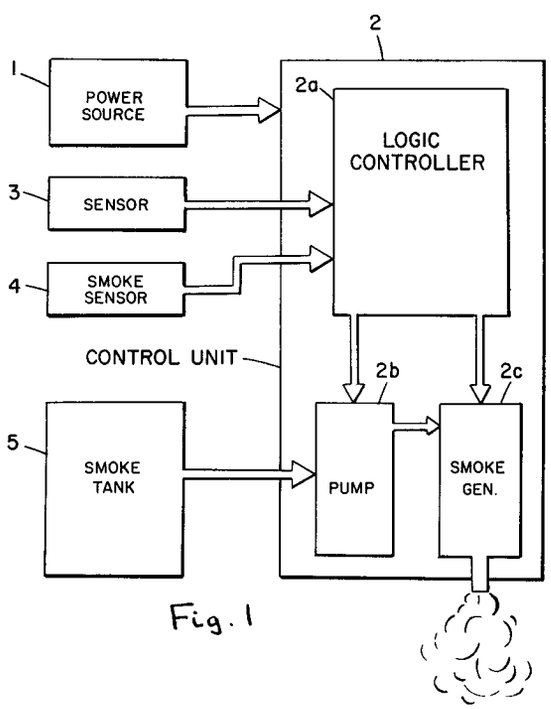

Fig. 1

EP 0 664 532 A1

This invention is directed to a system for defending or protecting an enclosed property, such as an automobile, in general, and to a Vehicle Defense System (VDS) using thick smoke (or fog) to protect the automobile and to scare away would be thieves silently, in particular.

Many types of alarms are known. These alarms include tamper alarms which indicate tampering with property. One type of property for which alarms are now very common is an automobile or similar vehicle. Audible alarms or warning devices have been known in the art for many years. One type is the conventional whistle which generally requires an external pressurized source of steam or air. Other types such as air-operated diaphragm horns found on vehicles, particularly trucks, require either a vacuum or pressure source. There is also known in the art fluid operated diaphragm horns using aerosol type pressurized fluid containers as an operating source. Many of these alarms are manually operated and require both the physical and mental attention of the operating person for actuation.

Thus, what is needed is an anti-burglar device which can be fired by a relatively small amount of mechanical force. Thus, a motion caused by an unauthorized movement of an object such as a door, window, or the like will trigger the device to protect the property for a sufficient period of time to provoke action in response to the alarm emitted. Alarm sirens are becoming less and less effective because they are heard frequently and are almost always ignored. No one pays attention to such alarms anymore. Thus, a new type of protective device is required.

VDS is a Vehicle Defense System (VDS) which, once triggered, generates enough smoke to completely engulf the interior of the protected property, e.g. a vehicle. This smoke attracts attention to the vehicle and visually impairs would be thieves from seeing valuables inside the vehicle. VDS can be used as an add-on to existing alarms or as a stand-alone defense system.
The smoke generated is harmless to humans and the interior of the vehicle.

VDS is a unique, effective defense or security system which protects silently. When used alone, it eliminates annoying false alarms.

This invention relates in general to apparatus for producing a fog-like or smoke-like cloud and in particular to apparatus which may quickly generate a dense non-toxic cloud. The invention relates especially to apparatus for vaporizing a non-toxic liquid in order to generate such a cloud to impair visibility within a protected area.

The generation of smoke-like or fog-like clouds to simulate fog or smoke or to create mysterious vision-obscuring special effects has long been used in theatrical performances. One method of producing a such vision-obscuring cloud, often used in theatrical performances, has been to use an elongated electrical heating element to heat a vaporizable liquid or "liquid smoke" disposed in a tube adjacent the heating element or coiled around the heating element. The heating element is typically of ferrous material and the heat is generated by the application of commercial ac power to the heating element. The low electrical resistivity of the ferrous heating element requires the heating element to have a relatively large mass to provide sufficient resistance for generating the amount of heat required to vaporize the liquid in the adjacent tube.

This, in turn, requires a relatively large amount of power (i.e.,the use of commercial ac power) to generate the required heating. The liquid smoke is heated relatively slowly to the vaporization temperature because the slow heating of the ferrous heating element. Once the vaporization temperature is reached and the vision-obscuring cloud is being produced, vaporization may not be quickly terminated because the heat stored in the ferrous heating element may continue to vaporize the liquid even after power has been removed. In addition, the transfer of the heat from the heating element to the vaporizable liquid in the tube adjacent to or coiled around the heating element is not efficient further slowing the heating of the liquid. Thus the vision-obscuring cloud is not quickly generated nor is the generation of the cloud quickly terminated.

These factors have combined to limit the ability to control the generation of a vision-obscuring cloud. There is a significant delay (as great as 10-15 minutes) between the beginning of heating of the heating element and the actual generation of the vision-obscuring cloud by vaporizing the liquid. The relatively large mass of the heating element means that residual heat will usually continue to heat and generate the cloud for a significant time after power is removed. This lack of control means that there is a greater likelihood that some of the vaporizable liquid in the tube will become overheated and bum, thereby producing actual smoke. Burning of course is not desirable and will often produce an objectionable odor and may even present a fire danger if proper safety precautions are not implemented.

In the inventors copending U.S. Patent Application, Serial Number 08/183,942, entitled "Vehicle Defense System", an anti-burglar or anti-theft device is disclosed in which a dense, non-toxic, smoke-like or fog-like cloud is generated to engulf the interior of the protected property (i.e., a vehicle) to form a barrier to an intruder and to provide a highly visible indication that there has been an

intrusion or an attempted intrusion of the protected property. In such a vehicle protection device, the generation of the vision-obscuring cloud must be very fast when the device is activated and repeatable upon multiple activations. The generation of the cloud must be able to be terminated quickly in order discontinue accidental activations and to conserve the vaporizable cloud-forming material and enhance the capacity of the system. In the case of a vehicle system, power is preferably provided by battery power such as by a 12 volt car battery. The apparatus is preferably compact for easy location and/or concealment in the vehicle. The prior methods and apparatus for generating vision-impairing clouds are not suitable for the requirements of an anti-theft or vehicle protection device.

Accordingly, there is a need for apparatus for generating a vision-obscuring cloud without the disadvantages of the prior methods.

It is therefore an object of the present invention to generate a smoke-like or fog-like cloud to obscure the view into or out of the cloud.

Another object of the present invention is to generate a vision-obscuring cloud that is easily recognized by intruders and observers.

Another object of the present invention is to provide apparatus for quickly generating a non-toxic vision-obscuring cloud and quickly terminating generation of such cloud.

Another object of the present invention is to quickly fill a confined space with a vision-obscuring cloud.

Yet another object of the present invention is to generate a dense non-toxic vision-obscuring cloud at a high rate.

A further object of the present invention is to provide low power apparatus for generating a non-toxic vision-obscuring cloud.

Still another object of the present invention is to provide battery-operated low power apparatus for generating such a vision-obscuring cloud.

A still further object of the present invention an economical, reusable, and compact apparatus for generating a vision-obscuring cloud.

These and other objects are provided in the present invention in which a vaporizable liquid is supplied under pressure into the inlet end of a coiled heating tube. A source of electric potential is selectively coupled between the ends of the coiled heating tube to generate a current through the length of the tube that heats the tube and the vaporizable liquid within the tube to produce a cloud of vaporized liquid at the outlet end of the tube. A thermocouple is disposed near the outlet end of the heating tube to measure the temperature of the tube. The vaporizable liquid is selectively supplied to the heating tube and the electric potential is selectively coupled to the heating tube in response to the measured temperature of the tube near the outlet of the tube to vaporize the liquid without burning the liquid.

Other objects and many of the attendant advantages will be readily appreciated as the subject invention becomes better understood by reference to the following detailed description, when considered in conjunction with the accompanying drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a block diagram of the property security system of a preferred embodiment of the instant invention;

Fig. 2 is a schematic block diagram of another preferred embodiment of the cloud generating apparatus of the present invention;

Fig. 3 is a pictorial view of a preferred embodiment of a coiled heating tube according to the present invention;

Fig. 4 is a sectional view of the coiled heating tube of Fig. 3, and

Fig. 5 is a partially schematic, partially pictorial view illustrating the coiled heating tube disposed in an insulator.

DESCRIPTION OF A PREFERRED EMBODIMENT

Referring now to Figure 1, there is shown a power source 1, which can be a car battery, for example. This power source is used to provide necessary power, for example 12 volts, required to operate the system of the instant invention.

The power source 1 is connected to the control unit 2 which consists of three major components which include a logic controller 2a, a liquid pump 2b and a smoke generator 2c. In particular, the logic controller 2a controls the liquid pump 2b and the smoke generator 2c. The pump 2b draws liquid smoke from a holding or smoke tank 5.

Liquid smoke (which is readily available in the market) is a liquid material which is converted into harmless white smoke when heated in the smoke generator 2c. The smoke 6 is exhausted from the smoke generator 2c and the main control unit 2, as shown in the Figure. Inasmuch as the control unit 2 is mounted within the vehicle (or other enclosed property), the smoke tends to fill the area or volume of the enclosed property to the extent and density which is desired. As noted, the density of the smoke is intended to alert passersby or to render it difficult for anyone to operate the vehicle or function in the enclosed property.

The outside sensors are located outside the vehicle and are responsible for sending the control signal to the logic controller 2a to activate the VDS of the instant invention. These outside sensors can

be of any conventional design or operational capability and are well known in the market.

The smoke sensors 4 determine if enough smoke has been generated and signal to the logic controller 2a to stop generating more smoke, for example, by deactivating the liquid pump 2b in order to discontinue drawing liquid smoke from the holding tank 2c and/or to disconnect the power source from a heating element enclosed in the smoke generator to thereby terminate the conversion of liquid smoke to gaseous smoke.

The liquid smoke tank 5 is a holding or storage tank which holds the liquid smoke material used to generate gaseous smoke by smoke generator 2c.

Thus, as noted above, the device operates to incorporate several major components which are powered by a 12 volt car battery. In operation, the outside sensors 3 sense or detect any violation or insult to the integrity of the vehicle and produce or send a signal to the logic controller 2a. The signal to the logic controller 2a is used to determine whether or not to trigger the VDS. Outside sensors 3 can include shock sensors, motion sensors, and/or radar sensors. These are all conventional sensors which are used in conjunction with other existing vehicle alarm systems.

When the logic controller 2a receives a signal from the outside sensors 3 and determines that a valid activating signal has been generated, the logic controller 2a sends a signal to the liquid pump 2b and to the smoke generator 2c to begin pumping the liquid smoke to the smoke generator 2c, respectively. That is, the pump 2b is rendered operative only when a signal from logic controller 2a is received. The pump 2b draws liquid smoke from the holding tank or smoke tank 5 and pumps the liquid smoke into smoke generator 2c. As noted infra, the pump 2b is turned off when a stop signal from logic controller 2a is received.

The smoke generator 2c receives the liquid smoke from the storage tank 5 via pump 2b. When smoke generator 2c receives a control signal from logic controller 2a, the smoke generator 2c is rendered operative to heat the liquid smoke until it is converted to gaseous smoke. At that point, the smoke generator 2c begins spewing gaseous smoke from the main control unit to the interior of the vehicle, as shown by the smoke coil 6 in the Figure. The smoke generated by VDS is an odorless, harmless smoke which will not cause irritation to the skin or eyes and will not harm the interior of any vehicle.

The system continues to operate to produce smoke while the smoke sensors 4, mounted inside the vehicle but outside the control unit 2, sense and detect the amount of smoke generated. When the smoke has reached a predefined level, i.e. density, consistency or the like, the smoke sensors 4 supply a signal to the logic controller 2a to terminate the operation of the liquid pump and smoke generator. Thus, VDS is unique in that it is also a defense system. That is, once triggered, it is difficult to impossible to see valuables inside the vehicle. Moreover, the smoke will attract enough attention to deter would-be thieves. The system is then deactivated until reactivated in accordance with the procedures noted above.

Thus, there is shown and described an automobile defense system that can be added to existing car alarms or can be used as a stand-alone defense system. Once a violation to the vehicle is sensed by the outside vehicle sensors, the VDS releases enough smoke to substantially completely fill the interior of the car. The smoke which is released is harmless, odorless and non-toxic whereby it causes no harm to humans or the interior of the protected car.

While this description is directed to a particular embodiment, i.e. automobiles, it is understood that those skilled in the art may conceive modifications and/or variations to the specific embodiments shown and described herein. For example, the same technology could be used to protect homes, commercial buildings, banks or the like. Moreover, by using AC power and/or larger smoke generators, more smoke can be generated to protect the above-mentioned properties.

DESCRIPTION OF THE OTHER PREFERRED EMBODIMENT

Referring now to the drawings and, in particular to Fig. 2, the other preferred embodiment of the present invention includes a coiled heating tube 10' having its inlet end coupled through a liquid inlet line 12' to the outlet of a pump 14'. The inlet of the pump 14' is coupled to the outlet of a liqud holding tank 16' via line 18'. The liquid holding tank 16' provides a reservoir for holding a liquid of the type that may be vaporized in the coiled heating tube 10' to produce a smoke-like of fog-like cloud 20' of diffused matter suspended in air to impair its transparency at the output 22' of the heating tube. The vaporized liquid is drawn from the holding tank 16' and supplied under pressrue to the interior of the heating tube 10' by the pump 14'. The vaporized liquid may alternatively be supplied under pressure to the interior of the heating tube 10' from a pressurized tank or bladder.

A source of electric potential such as a battery 24' is coupled between the ends of the coiled heatign tube 10' through the contacts of a first relay 26' to selectively supply power (current) to the heating tube. A standard 12 volt automotive battery is suitable for use as the battery 24'. The current provided by the battery 24' generates heat

in the coiled heating tube 10' due to the resistance of the heating tube. The heating tube 10' in turn heats the vaporizable liquid which is being pumped through the interior of the heating tube or supplied under pressure to the interior of the tube. The design of the coiled heating tube 10 is most important to the operation of the present invention and will be discussed more fully in connection with Figs. 2, 3 and 4. The first relay 26' is actuated by a controller 28' via line 30' to connect or disconnect the battery from the coiled heating tube 10' and thus control the generation of heat in the heating tube.

The battery 24' is also coupled via the contacts of a second relay 32' to selectively activate the pump 14' (or connect a pressurized bladder) to provide the vaporizable liquid to the coiled heating tube 10' under pressure. The second relay 32' is actuated by the controller 28' via line 34'. The temperature of the coiled heating tube 10' is sensed by a thermocouple 36' disposed near the tubes's outlet 22' and coupled to the controller 28' over line 38'. The controller 28' actuates the relays 26' and 32' to apply power from the battery 24' and activate the pump 14', respectively, based on the temperature of the heating tube 10' as measured by the thermocouple 36' to accomplish the vaporization of the liquid in the heating tube without overheating or burning.

Referring now to Figs. 2, 3 and 4, which illustrate an operative preferred embodiment of the coiled heating tube 10' that is especially useful in a vehicle security system employing the present invention, the coiled heating tube is of circular cross section although other cross-sectional shapes are may be employed within the teachings of the invention. The operative embodiment of the heating tube 10' is intended to operate with the preferred vaporizable liquid - propylene glycol (CH_3-CHOH-CH_2OH) and/or glycerine ($C_3H_5(OH)_3$ available from Dow Chemical of Midland, Michigan. The propylene glycol and/or glycerine are preferably in solution with water (approximately 20% water for a freezing point of below 20 °F) to provide a freezing point of the liquid below the expected low temperature of the location where the liquid will be stored. In the case of a vehicle security system, the holding may tank in the passenger compartment, the trunk or in the engine compartment. Vaporization of the propylene glycol and/or glycerine water solution provides a dense visibility-impairing cloud which is odorless, tasteless, and non-toxic.

The length, cross sectional area, diameter and material of the coiled heating tube 10 are chosen to enable a current supplied by a 12 volt automotive battery to heat the tube very quickly and also provide a controlled vaporization of the propylene glycol and/or glycerine water solution as the vaporizable liquid. Inconel™ Alloy 600, manufactured by Inco Alloys International, Inc. and having chemical composition (by %) of Ni 76.0, C 0.04, Mn 0.20, Fe 7.20, S 0.007, Si 0.20, Cu 0.10 and Cr 15.8 is a preferred material for the heating tube 10. The Inconel™ Alloy 600 has an electrical resistivity (approximately 620 ohms/cir mil/ft at 68 °F) which remains fairly constant over the temperature range to which the heating tube is subjected (up to 500 °F or higher). In contrast to Alloy 600, the resistivity of ferrous-based materials is much lower at room temperature and typically will decrease markedly as the temperature of the material increases to the upper end of this temperature range. As illustrated in the sectional view of Fig. 4, the Inconel™ Alloy 600 heating tube in the operative preferred embodiment has an inside diameter 40 of 0.050 inches and a wall thickness 42 of 0.020 inches. The tube has a length (uncoiled) of approximately 4.5 feet which results in a resistance from end to end of approximately 0.5 ohms. The current supplied by a 12 volt battery results in very fast heating of the tube. As will be discussed hereinafter, the dimensions of the tube are also chosen to facilitate the vaporization of the liquid without burning.

Materials that are substantially more conductive than Alloy 600 such as ferrous based materials (i.e., 40 or more per cent Fe) are not preferred materials for the heating tube 10 because their lower resistivity requires much more mass to obtain the resistance required for heating and therefore much more time and energy are required to heat the tube through the desired temperature range for vaporizing the liquid. In general, a metal having a resistivity of from 500 to 700 ohms/cir mil/ft is preferred for the heating tube 10 with 600-650 ohms/cir mil/ft being the most preferred. It is noted that materials having resistivities outside the 500 to 700 ohms/cir mil/ft range can be used for the heating tube 10' in the present invention, but that design of the heating tube and the amount of power required for heating may require adjustment to provide the desired performance in the present invention.

As most clearly illustrated in Fig. 3 the heating tube 10' is formed into a cylindrical coil having an inside diameter of approximately 0.5 inches. This results in a compact coiled heating tube having a coiled length of approximately 3.0 inches. Although closely wound to form a compact coil, the individual turns of cylindrical coil do not touch each other in order to ensure that the current flows through the entire length of the heating tube (i.e., no short circuits), thereby heating throughout of the entire cylindrical coil and the maintaining the tube resistance to the desired value for use with a 12 volt automotive battery. Coiling the heating tube 10'

intensifies the heating of the tube and the liquid within the tube because the heat radiated from each turn of the coil reinforces the heating of the other coils. The cylindrical coil further promotes efficient heating by reducing the loss of heat to the surrounding environment (especially compared to the amount of heat loss that would be present with an uncoiled heating tube).

The cylindrical coil 10' is preferably surrounded by insulation to contain the heat generated by the coil within the coil to promote heating of the coil and the liquid and to protect adjacent components and areas from exposure to the high temperatures of the coil. As shown in Fig. 5 the cylindrical heating coil 10' is disposed within a hollow cylinder 44' of alumina silica. The insulating cylinder 44' may conveniently be formed by two hollow half cylinders (the top half is shown in phantom) that are joined around the heating coil 10' and held together by suitable means such as adhesive on the mating edges or simply by wrapping with adhesive tape. As illustrated, the insulating cylinder 44' is adapted to permit the ends of the heating tube 10' and the wires for the battery 24' and the connection for the thermocouple 36' to extend through the walls of the cylinder for connection those components.

In operation, the system is actuated when the controller 28' closes relay 26' to couple the battery to the ends of the coiled heating tube 10'. This produces a current flowing through the length of the coiled heating tube which heats the tube at a very fast rate because of the use of high resistivity Inconel™ Alloy 600 for the tube, the specific dimensions of the tube, and the coiling of the tube. The temperature of the heating tube 10' is measured by the thermocouple disposed near the outlet end 22' of the tube and coupled to the controller 28'.

When the heating tube 10', heated by the current supplied by the 12 volt battery, reaches a temperature of 300°F at the thermocouple 36' (This temperature is reached in 3 to 4 seconds after the application of the current from the battery 24' in this preferred embodiment), the controller 28' closes relay 32' to couple the battery to energize the pump 14'. In the operative embodiment, the pump 14' provides the vaporizable fluid from the tank 16' to the input end of the coiled heating tube at a rate of approximately 15 ml per minute. The controller 28' continues heating the heating tube which now has the vaporizable liquid flowing through it.

The liquid is heated as it flows through the coiled heating tube 10' and is vaporized within the tube to form a dense cloud of vaporized liquid which is ejected from the tube at the outlet 22'. When the temperature sensed by the thermocouple 36' reaches approximately 500°F, controller 28' interrupts power to the heating tube 10' by opening relay 26' to discontinue heating the liquid. However, the pump 14' continues to provide the liquid to the heating tube 10' and the liquid continues to be vaporized by the residual heat in the tube. When the temperature measured by the thermocouple 36' falls to 350°F, the controller 28' closes relay 26' to resume heating the coil 10'.

When the desired vision-impairing cloud has been generated, the controller 28' interrupts power to the pump 14' by opening relay 32' to discontinue supplying the vaporizable liquid to the heating tube. A visibility sensing means (not shown) such as a light emitting diode (LED) and a corresponding sensor may be used to detect the presence of the cloud to discontinue the cloud generation. Alternatively, based on the volume of cloud required to obscure the target area or volume (such as 10 seconds for a small vehicle or 20 seconds for a large vehicle), the pump 14 may be turned off after an appropriate predetermined duration of time has passed since initiation of the cloud generating cycle. After the supply of liquid to the heating tube 10' is discontinued, the battery power continues to be applied to the heating tube for approximately 10 to 15 seconds in order to vaporize all the remaining liquid in the tube and is then disconnected by the controller 28' opening relay 26'. If the liquid is allowed to cool and remain in the heating tube, this remaining liquid will sputter when the heating tube 10' is first activated in the next cloud generating cycle. Similarly, if the battery power was currently disconnected from the heating tube 10' when the flow of liquid was stopped by disconnecting battery power from the pump 14', the relay 26' is closed by the controller 28' to connect the battery 24' for a few seconds to heat the tube 10' to ensure that all of the liquid in the tube is vaporized.

In addition, if the temperature of the tube falls below 300°F, the controller 28' opens relay 32' to disconnect the pump. If the liquid continues to be pumped into the heating tube when the tube is at this low temperature, there may be incomplete vaporization of the liquid in the tube resulting in the ejection of unvaporized liquid along with vaporized liquid.

The specific dimensions and materials of the coiled heating tube 10' and the flow rate of the pump 14' in the operative preferred embodiment have been chosen to provide a vision-impairing cloud as specifically useful in a vehicle security system application of the present invention and employing the preferred vaporizable liquid. It is noted that within the foregoing design of the operative embodiment, if the wall 42' of the heating tube 10' is made thicker, the tube will have better

conductivity. However, a longer tube will then be required to provide the preferred 0.5 ohms resistance and the longer tube will not heat as quickly. Alternatively, if the tube wall is made thinner, the tube will have less conductivity and will generate heat more quickly. However, the heating tube 10' may become too hot, too quickly, causing the vaporizable liquid to burn, thereby producing smoke rather than a dense cloud of vaporized liquid. If the heating tube 10' is made longer, the vaporizable liquid will be heated within the tube for a longer time which may also cause the liquid to burn rather than vaporize. Similar considerations are applicable to the choice of the diameter of the heating tube. It will be recognized that the dimensions of the heating tube, the kind of vaporizable liquid and method of supplying it and the like, may be chosen for a specific application within the teachings of the present invention.

While the preceding description has been directed to particular embodiments, it is understood that those skilled in the art may conceive modifications and/or variations to the specific embodiments and described herein. Any such modifications or variations which fall within the preview of this description are intended to be included therein as well. It is understood that the description herein is intended to be illustrative only and is not intended to limit the scope of the invention.

It should be noted that the Objects and advantages of the invention may be attained by means of any compatible combination(s) particularly pointed out in the items of the following summary of the invention and the appended claims.

2. A property defense system comprising,
first sensor means for detecting a particular condition and producing a first signal representative of said condition,
smoke generating means selectively rendered operative to produce a non-toxic smoke in response to said first signal from said first sensor means representative of said first condition, and
second sensor means for selectively deactivating said smoke generating means in response to a second signal from said second sensor means.

3. The system 2 wherein,
said smoke is an odorless, non-toxic smoke.

4. The system 2 including,
power source means.

5. The system 2 wherein,
said power source comprises a DC battery.

6. The system 2 wherein,
said smoke generating means includes a liquid smoke source, and
means for heating said liquid smoke to form a gaseous smoke.

7. The system 6 including,
pump means for transferring said liquid smoke from said liquid smoke source to said means for heating.

8. The system 2 wherein,
said property comprises an enclosed housing,
said first sensor means is mounted external to said housing,
said second sensor means is mounted internal to said housing.

9. The system 3 wherein,
said second sensor means includes a smoke detection means.

10. The system 8 wherein,
said enclosed housing comprises a vehicle.

11. A vehicle security system comprising,
control means,
battery means connected to said control means,
said control means includes logic controller means,
liquid pump means connected to said logic controller means,
smoke generator means connected to said logic controller means and said liquid pump means to selectively produce harmless smoke,
tank means for holding liquid smoke,
said tank means connected to said liquid pump means,
first sensor means connected to supply a first signal to said logic controller means selectively to initiate action thereby, and
second sensor means connected to supply a second signal to said logic controller means to terminate action thereby.

1. Apparatus for generating a visibility-impairing cloud comprising:
tubular means having a first end for receiving a liquid to be vaporized and a second end;
means for providing said liquid to the first end of said tubular means under pressure; and
means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means, said vaporized liquid being expelled from said second end of said tubular means to provide said visibility-impairing cloud..

2. Apparatus wherein said tubular means is coiled.

3. Apparatus wherein said means for applying an electric potential between separated locations along said tubular means comprises means for applying an electric potential between locations near each end of said tubular means.

4. Apparatus wherein said means for applying an electric potential between separated locations along said tubular means comprises means for applying an electric potential between locations near each end of said tubular means

5. Apparatus 1 further comprising:

means for controlling the heating of said tubular means.

6. Apparatus 1 further including:

a) means for measuring the temperature of said tubular means; and

wherein said means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means includes means for selectively connecting and disconnecting said electric potential from said tubular means in accordance with the measured temperature of said tubular means.

7. Apparatus wherein said means for measuring the temperature of said tubular means includes a thermocouple disposed for measuring the temperature of said tubular means near the second end of said tubular means.

8. Apparatus 2 further comprising:

means for controlling the heating of said tubular means.

9. Apparatus 2 further including:

a) means for measuring the temperature of said tubular means; and

wherein said means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means includes means for selectively connecting and disconnecting said electric potential from said tubular means in accordance with the measured temperature of said tubular means.

10. Apparatus 9 wherein said means for measuring the temperature of said tubular means includes a thermocouple disposed for measuring the temperature of said tubular means near the second end of said tubular means.

11. Apparatus 1 further including means for thermally insulating said tubular means.

12. Apparatus 2 further including means for thermally insulating said tubular means.

13. Apparatus 1 wherein said means for providing said liquid to said tubular means under pressure includes pump means.

14. Apparatus 2 wherein said means for providing said liquid to said tubular means under pressure includes pump means.

15. Apparatus 1 wherein said liquid to be vaporized is selected from the group of propylene glycol, glycerine, a solution of propylene glycol in water, a solution of glycerine in water and a solution of propylene glycol and glycerine in water.

16. Apparatus 2 wherein said liquid to be vaporized is selected from the group of propylene glycol, glycerine, a solution of propylene glycol in water, a solution of glycerine in water and a solution of propylene glycol and glycerine in water.

17. A method for vaporizing a liquid to provide a cloud of diffused matter suspended in air and impairing its transparency:

a) supplying a vaporizable liquid under pressure to a heating tube;

b) heating said heating tube to vaporize said vaporizable liquid in said heating tube by applying an electric potential between separated locations on said heating tube.

18. A method 17 further including:

a) measuring the temperature of said heating tube; and

b) selectively applying and not applying said electric potential to said heating tube in accordance with the measured temperature of said heating tube.

19. A method 18 further including selectively supplying and not supplying a vaporizable liquid under pressure to said heating tube in accordance with the measured temperature of said heating tube.

20. A method 17 further including selectively supplying and not supplying a vaporizable liquid under pressure to said heating tube in accordance with the measured temperature of said heating tube.

21. A method 17 wherein the step of supplying a vaporizable liquid under pressure to a heating tube comprises supplying a vaporizable liquid to a coiled heating tube.

Claims

1. A property defense system comprising,

first sensor means for detecting a particular condition and producing a first signal representative of said condition,

smoke generating means selectively rendered operative to produce a non-toxic smoke in response to said first signal from said first sensor means representative of said first condition, and

second sensor means for selectively deactivating said smoke generating means in response to a second signal from said second sensor means.

2. The system recited in claim 1 wherein,

said smoke is an odorless, non-toxic smoke, preferably including, power source means,

wherein preferably said smoke generating means includes a liquid smoke source, and

means for heating said liquid smoke to form a gaseous smoke, preferably including,

pump means for transferring said liquid smoke from said liquid smoke source to said means for heating,

wherein preferably

said property comprises an enclosed housing,

said first sensor means is mounted external to said housing,

said second sensor means is mounted internal to said housing,

said second sensor means preferably including a smoke detection means, and

wherein preferably

said enclosed housing comprises a vehicle.

3. A vehicle security system comprising,

control means,

battery means connected to said control means,

said control means includes logic controller means,

liquid pump means connected to said logic controller means,

smoke generator means connected to said logic controller means and said liquid pump means to selectively produce harmless smoke,

tank means for holding liquid smoke,

said tank means connected to said liquid pump means,

first sensor means connected to supply a first signal to said logic controller means selectively to initiate action thereby, and

second sensor means connected to supply a second signal to said logic controller means to terminate action thereby.

4. Apparatus for generating a visibility-impairing cloud comprising:

tubular means having a first end for receiving a liquid to be vaporized and a second end;

means for providing said liquid to the first end of said tubular means under pressure; and

means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means, said vaporized liquid being expelled from said second end of said tubular means to provide said visibility-impairing cloud..

5. Apparatus as recited in Claim 4 wherein said tubular means is coiled.

6. Apparatus as recited in Claim 4 wherein said means for applying an electric potential between separated locations along said tubular means comprises means for applying an electric potential between locations near each end of said tubular means.

7. Apparatus as recited in Claim 2 wherein said means for applying an electric potential between separated locations along said tubular means comprises means for applying an electric potential between locations near each end of said tubular means,

further preferably comprising:

means for controlling the heating of said tubular means,

further preferably including:

a) means for measuring the temperature of said tubular means; and

wherein said means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means includes means for selectively connecting and disconnecting said electric potential from said tubular means in accordance with the measured temperature of said tubular means, and

wherein preferably said means for measuring the temperature of said tubular means includes a thermocouple disposed for measuring the temperature of said tubular means near the second end of said tubular means.

8. Apparatus as recited in Claim 2 further comprising:

means for controlling the heating of said tubular means,

further preferably including:

a) means for measuring the temperature of said tubular means; and

wherein said means for applying an electric potential between separated locations along said tubular means to heat said tubular means and thereby to heat said liquid to a temperature sufficient to vaporize the liquid in the tubular means includes means for selectively connecting and disconnecting said electric potential from said tubular means in accordance with the mea-

sured temperature of said tubular means,

wherein preferably said means for measuring the temperature of said tubular means includes a thermocouple disposed for measuring the temperature of said tubular means near the second end of said tubular means,

further preferably including means for thermally insulating said tubular means,

further preferably including means for theramally insulating said tubular means,

wherein preferably said means for providing said liquid to said tubular means under pressure includes pump means,

wherein preferably said means for providing said liquid to said tubular means under pressure includes pump means,

wherein preferably said liquid to be vaporized is selected from the group of propylene glycol, glycerine, a solution of propylene glycol in water, a solution of glycerine in water and a solution of propylene glycol and glycerine in water, and

wherein preferably said liquid to be vaporized is selected from the group of propylene glycol, glycerine, a solution of propylene glycol in water, a solution of glycerine in water and a solution of propylene glycol and glycerine in water.

9. A method for vaporizing a liquid to provide a cloud of diffused matter suspended in air and impairing its transparency:

a) supplying a vaporizable liquid under pressure to a heating tube;

b) heating said heating tube to vaporize said vaporizable liquid in said heating tube by applying an electric potential between separated locations on said heating tube.

10. A method as recited in Claim 9 further including:

a) measuring the temperature of said heating tube; and

b) selectively applying and not applying said electric potential to said heating tube in accordance with the measured temperature of said heating tube,

further preferably including selectively supplying and not supplying a vaporizable liquid under pressure to said heating tube in accordance with the measured temperature of said heating tube,

further preferably including selectively supplying and not supplying a vaporizable liquid under pressure to said heating tube in accordance with the measured temperature of said heating tube, and

wherein preferably the step of supplying a vaporizable liquid under pressure to a heating tube comprises supplying a vaporizable liquid to a coiled heating tube.

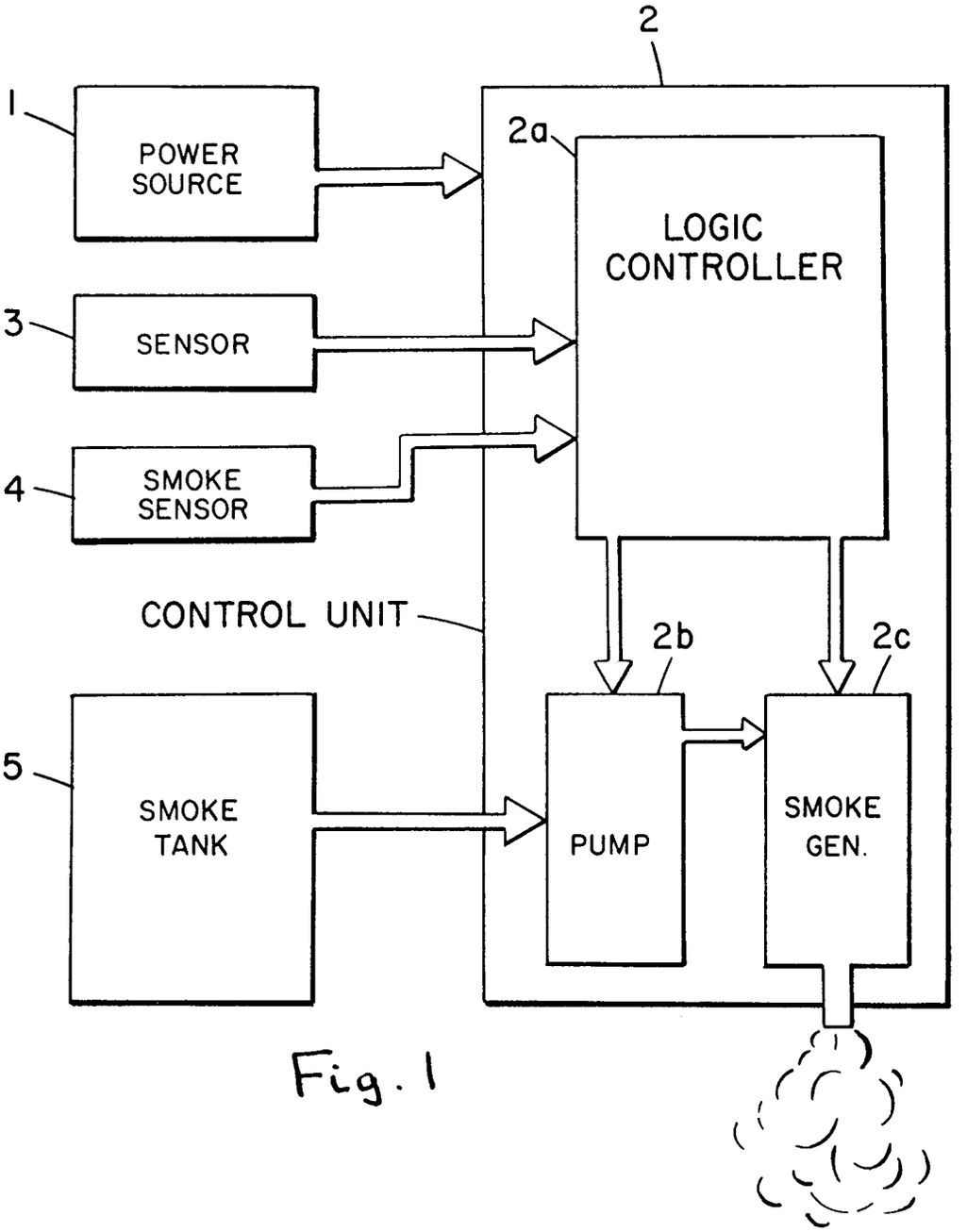
2
1
POWER SOURCE
2a
LOGIC CONTROLLER
3
SENSOR
4
SMOKE SENSOR
CONTROL UNIT
2b
2c
5
SMOKE TANK
PUMP
SMOKE GEN.

Fig. 1

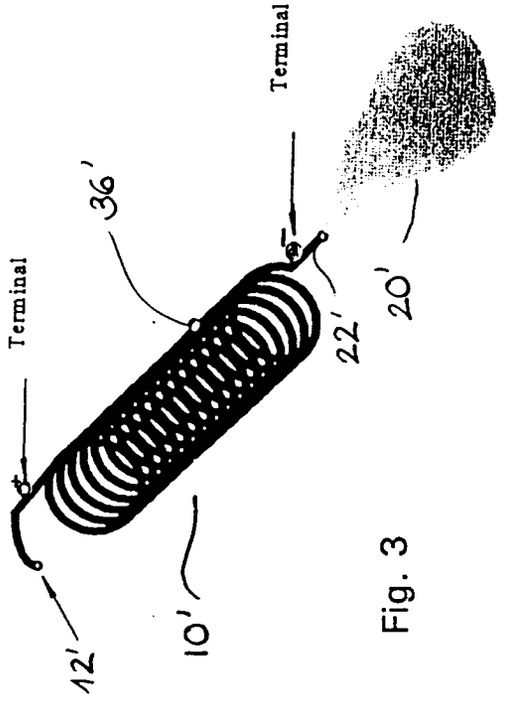

Fig. 3

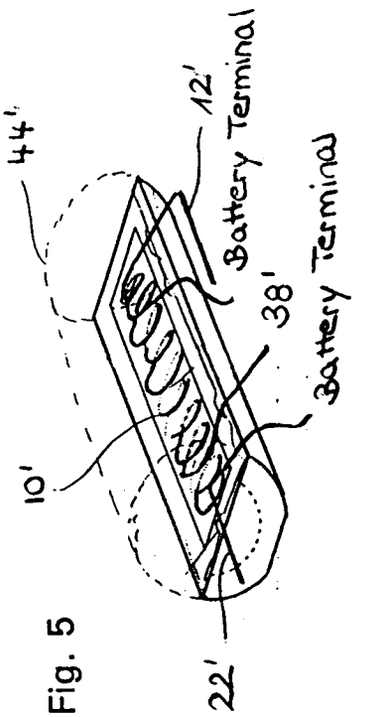

Fig. 5

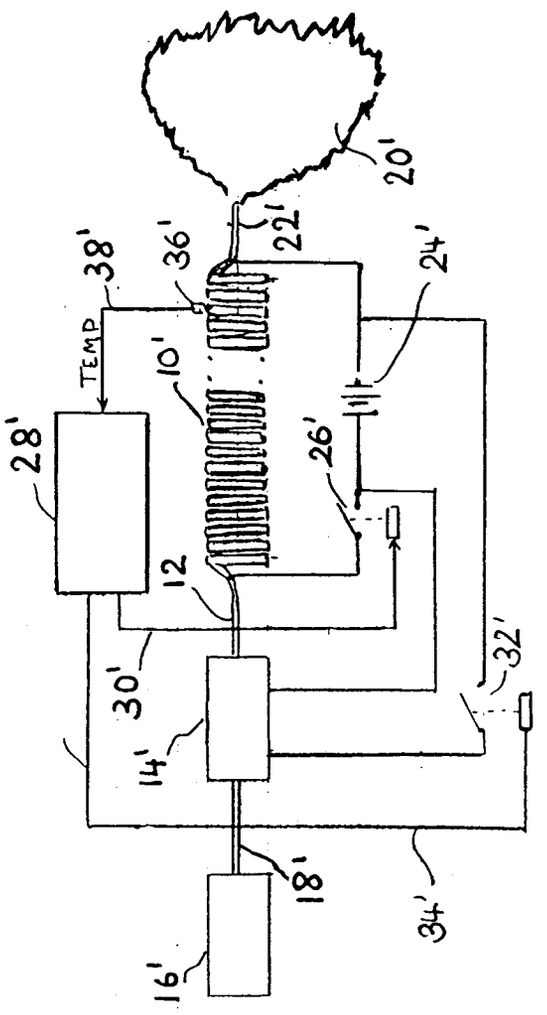

Fig. 2

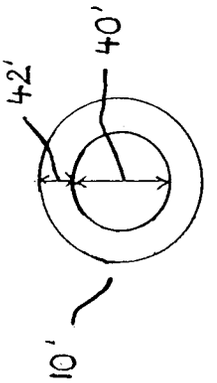

Fig. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 94 11 9992

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.Cl.6)
Y	GB-A-2 247 094 (R. A. PROCTOR) * abstract; figure 1 *	1,3	G08B15/02
Y	EP-A-0 475 800 (ADESCO) * column 3, line 56 - column 4, line 5; figure 1 * * claim 2 *	1,3	
Y	US-A-4 326 119 (E. SWIATOSZ) * abstract; figure 1 *	4,9	
Y	NAVY TECHNICAL DISCLOSURE BULLETIN, vol.8, no.3, March 1983, WASHINGTON US pages 85 - 87 E. SWIATOSZ 'Resistance tubular heater/nozzle smoke generator' * the whole document *	4,9	
A,P	WO-A-94 07223 (P. A. DARDS) * abstract; figure 1 *	1-3	
A	US-A-4 764 660 (E. SWIATOSZ) * column 3, line 3 - line 55; figures 1,2 *	2,5-8	TECHNICAL FIELDS SEARCHED (Int.Cl.6) G08B B60R F41H
A	US-A-4 818 843 (E. SWIATOSZ) * abstract; figure 4 *	10	
A	WO-A-89 05018 (C. L. SAYERS) * abstract; figure 1 *		

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
BERLIN	12 April 1995	Breusing, J

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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