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**Hedman et al.**

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(54) **METHOD OF KILLING ORGANISMS AND REMOVAL OF TOXINS IN ENCLOSURES**

(76) **Inventors:** David Hedman, 7750 Sulphur Mountain Rd., Ojai, CA (US) 93023; Troy Sears, 4582 Da Vinci St., San Diego, CA (US) 92130

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(58) **Field of Search** ..... 43/124, 132.1

(56) **References Cited**

**U.S. PATENT DOCUMENTS**

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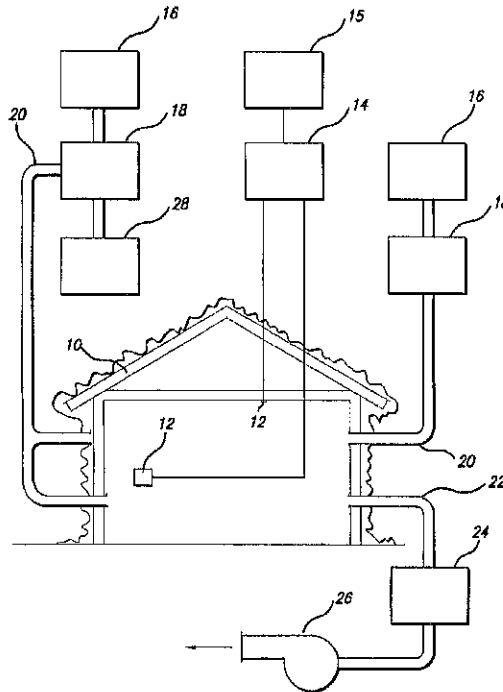
*Primary Examiner*—Kurt Rowan

(74) *Attorney, Agent, or Firm*—O'Melveny & Myers LLP

(57) **ABSTRACT**

A method and kit of components for destroying organisms and toxins in from an enclosure such as a building. Temperature sensing probes are installed in the enclosure to indicate structure temperature and a recorder is used to record the temperature of said sensing probes in real time. Hot air is introduced into the enclosure through one or more ducts to raise the structure temperature to at least about 120° F., as monitored by the temperature sensing probes. This is sufficient to kill essentially all insects, bacteria, virus, dust mites, spiders, silver fish, fungi and toxic molds such as *aspergillus oryzae*, *aspergillus terreus*, *aspergillus versicolor*, *cladosporium herbarum*, *stachybotrys chartarum*, *penicillium aurantiogriseum*, *penicillium chrysogenum*, *penicillium glabrum* and *fusarium oxysporum*, and the like. The air can exit through open doors and windows or through ducts to a filter assembly that captures the remains of the organisms. Ozone may be added to the heated air to improve efficiency. Preferably, air when extracted from an egress duct downstream of the filters improves air flow through the enclosure and filters. A typical building can be treated in six to eight hours.

8 Claims, 2 Drawing Sheets



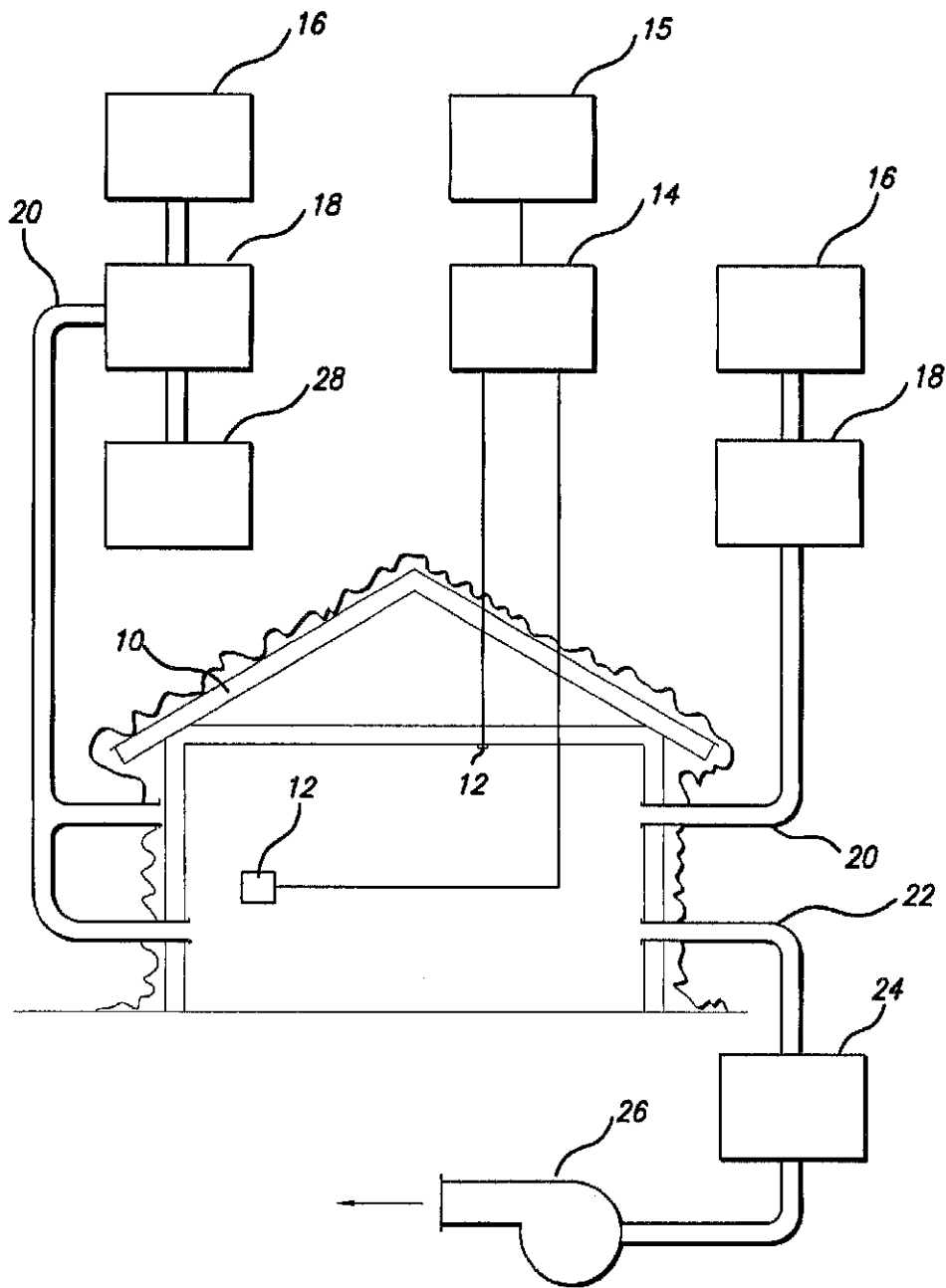


FIG. 1

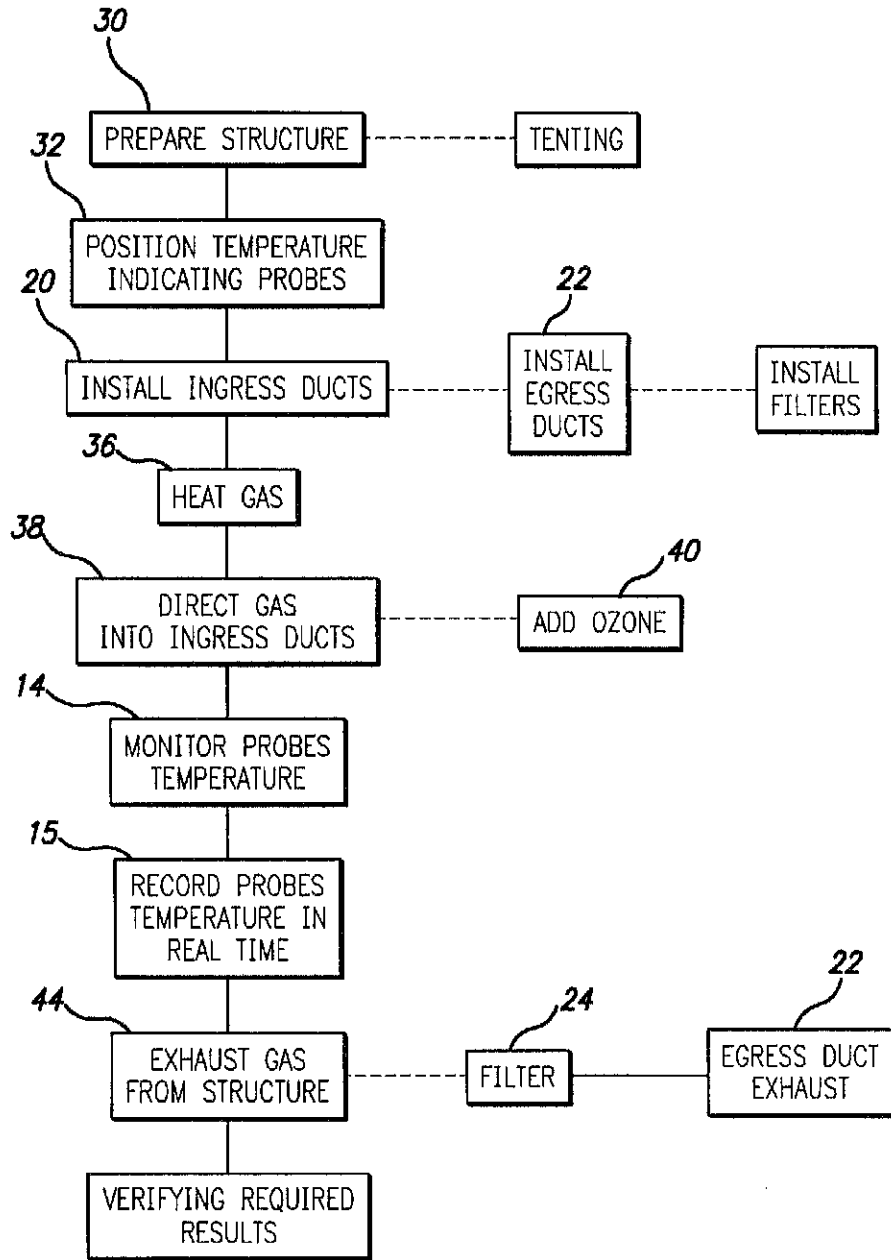


FIG. 2

## METHOD OF KILLING ORGANISMS AND REMOVAL OF TOXINS IN ENCLOSURES

### FIELD OF THE INVENTION

This invention relates to methods of sanitizing buildings and other enclosed spaces by killing and removing organisms such as insects, bacteria, virus, dust mites, spiders, silver fish, fungi and toxic molds such as but not limited to *aspergillus oryzae*, *aspergillus terreus*, *aspergillus versicolor*, *cladosporium hergbarum*, *stachybotrys chartarum*, *penicillium aurantiogriseum*, *penicillium chrsogenum*, *penicillium glabrum* and *fusarium oxysporum*.

### BACKGROUND OF THE INVENTION

A large number of methods have been developed for killing insects, such as termites, in buildings. The most widely used method is tenting the building, then filling the building with a toxic gas for a period of time sufficient to kill termites or other selected insects. This method is effective for killing termites and other insects. However, this method generally requires 12 hours to be effective, requiring building occupants to move out businesses to be closed for approximately a three day period to insure proper venting of toxic material and/or gas. Tenting the building with heavy tarpaulins requires workers to walk and arrange the tarpaulins on the roof, often damaging shingles or other roofing materials. Food and medications must be placed in sealed containers or removed. Generally the entire building must be treated, even if the infestation is localized.

Because of the disadvantages of the toxic gas method, various other techniques of varying effectiveness have been developed, using heated air or very cold air to kill termites, electrical "shock" treatments, irradiation, non-ionizing, etc.

Typical of these is the method disclosed by Charles Forbes in U.S. Pat. No. 4,817,329, in which wood destroying insects, e.g., termites, are killed by applying a heated gas, such as heated air, to wooden surfaces until the building surfaces are heated to a temperature, typically about 120 to 135° F. Temperatures for killing other insects are said to be surprisingly close to this range. This method has been found to be very effective for killing termites. However, this method, using the described temperatures, is not effective for other organisms, such as fungi, and toxic molds such as, but not limited to, *aspergillus oryzae*, *aspergillus terreus*, *aspergillus versicolor*, *cladosporium hergbarum*, *stachybotrys chartarum*, *penicillium aurantiogriseum*, *penicillium chrsogenum*, *penicillium glabrum* and *fusarium oxysporum*. Further, many insects such as mites, fungi, molds and the like are a serious health hazard even when dead. Many people are allergic to the dust-like remains of these organisms that can also cause serious health problems. This is a particular problem to persons suffering from asthma, bronchitis, pneumoconiosis and other respiratory ailments.

Therefore, there is a continuing need for improved methods of killing organisms in enclosures such as buildings that are fully effective in killing and eliminating substantially all such organisms, is non-toxic, can be performed in a relatively short time, is clean, dry and odorless, and removes a large proportion of the dead organisms.

### SUMMARY OF THE INVENTION

The above-noted problems, and others, are overcome in accordance with this invention by a method which basically comprises the steps of preparing the enclosure to be treated, such as a building by, removing all heat sensitive items, positioning heat shields, etc., positioning temperature indicating probes at appropriate locations, inserted into building structure, open spaces, etc., installing ingress ducts through

which an environmentally acceptable gas, such as air, can be directed into the enclosure, allowing the gas to leave the enclosure by opening windows, doors, etc. or by installing an egress duct or ducts for this purpose, heating the gas and directing it into the ingress duct(s) when installed and filtering gas exhausting through open doors and windows and/or the egress ducts to collect organism remains and prevent them from entering the environment.

To increase system effectiveness, under some conditions, it is preferred that a suitable quantity of ozone be fed into the heated air passing through the ingress ducts. Ozone aids in killing many organisms and will eliminate any chemical fumes, odors, etc. that may result from the treatment.

To increase gas flow through the enclosure when egress ducts are employed, it is preferred that a vacuum extraction system be provided downstream of the filters receiving gas from the egress ducts. This will assure that almost all gas leaving the enclosure will pass through the filters and increase the capture of organism remains.

It is, therefore, an object of this invention to provide a non-toxic method for destroying a wide variety of organisms including fungi, toxic molds such as, but not limited to, *aspergillus oryzae*, *aspergillus terreus*, *aspergillus versicolor*, *cladosporium hergbarum*, *stachybotrys chartarum*, *penicillium aurantiogriseum*, *penicillium chrsogenum*, *penicillium glabrum* and *fusarium oxysporum* and insects in enclosures such as buildings and the like.

Another object of the invention is to remove substantially all of the remains of the killed organisms from open areas in the enclosure.

Yet another object is to filter gases leaving from the enclosure to prevent the allergenic organism remains from entering the environment.

A further object is to accomplish the destruction of the organisms in a relatively short period.

Still another object is to monitor the temperature level throughout the enclosure to assure that all areas reach the predetermined effective temperature.

### BRIEF DESCRIPTION OF THE INVENTION

Details of preferred embodiments of the invention are provided in the drawings, wherein:

FIG. 1 is a schematic diagram showing components of the system of this invention; and

FIG. 2 is a flow diagram of the method of this invention.

### DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIG. 1, there is seen a schematic diagram showing the components of the kit of this invention in use treating an enclosure 10. Typically, enclosure 10 may be a house, barn, shed, a business building or some portion of such a building. An enclosure 11, such as, but not limited to conventional tenting may be required to treat the exterior surface of enclosure 10.

A plurality of temperature sensors 12 are positioned at predetermined locations to monitor temperature of the structure. Typically, these sensors have thin, elongated, tips that can be adhered to or pushed into wood or other materials or into suitable sized holes drilled into such material so as to measure the surface and/or internal temperature. Sensors 12 may be wired to a console 14 which displays and records the temperature at each sensor in real time for future reference. Alternatively, the sensors may be wireless or infrared, transmitting a signal to console 14. Typical sensors, as for way of example and not by way of limiting, include thermal couples, thermistors, or the like connected to a computer and/or a strip chart recorder. Thermocouples can be pur-

chased from Togam under the model number 875F or any other commercial vendor having an equivalent sensor.

One or more heaters 16 heat a gas to the predetermined temperature. Preferably, the gas is air, although any other environmentally acceptable gas, such as nitrogen, may be used if desired. The gas is heated to at least a temperature lethal to the organisms to be destroyed. For a more complete disinfection, the gas temperature is preferably at least about 155° F., with optimum results generally be achieved with temperatures in the range of about 120 to 300° F.

Any suitable heater may be used. A gas burning heater, such as a conventional propane heater is preferred as being particularly efficient in heating air. Any other heating arrangement, such as electrical heaters, may be used if desired.

Heated gas from one or more heaters 16 is directed to a blower 18 (which may, if desired, be a component of the heater) which directs the hot gas into enclosure 10 through at least one ingress duct 20. Generally, a plurality of ducts 20 will be used to achieve the optimum distribution of hot gas throughout enclosure 10. Ingress ducts 20 preferably include variable flow dampers and may be moved while the system is in operation to achieve uniform temperatures in all areas being treated of the structure, as sensed by sensors 12 and observed at console 14.

When utilized, at least one egress duct 22 is provided to allow the gas to leave the structure. While it is preferred that enclosure 10 be maintained at a pressure slightly above atmospheric pressure as the hot gas brings the building elements up to the desired surface and penetration temperatures, the positive pressure differential allows the hot gas to vent through open windows, doors, etc. to and carries away the remains of the destroyed organisms upon venting. When the structure is sealed the duct or ducts 22, like the open windows and doors, carries away the remains of destroyed organisms. A filter assembly 24 receives gas from an egress duct 22 and removes the remains of the organisms preventing them from reaching the environment. Typical filters are available from Therna-Stor Products, Madison, Wis., under the Guardian HEPA system designation as for example and not by way of limitation, a UV filter is desired, however other filters suitable for the purpose intended can be utilized.

For optimum effectiveness, it is often desirable to increase gas flow rates by adding a blower 26 or other gas extraction means downstream of filter 24 to aid in extracting the gas from enclosure 10. This forced extraction increases the efficiency of filtering of the gas by filter 24.

In some applications, the introduction of ozone gas from ozone generator 28 into blower 18 or ingress duct 20 is highly desirable. This results in oxidation of organic contamination, such as molds where layering has occurred. Ozone generators suitable for use here are available from RGF O<sup>3</sup> Systems, Inc., under the TURBOZONE® trademark. Equivalent ozone generators suitable for the purpose intended can be used for the purpose.

In the operation of the system of this invention, the first step is to prepare the building, as indicated in block 30 of FIG. 2. This basically involves removing all heat sensitive items from the enclosure or, in some cases, covering heat sensitive items with thermal insulation material. All material that has a flash point below the maximum temperature to be used must be removed.

Next, a plurality of temperature indicating probes are placed in predetermined locations within the enclosure as indicated in block 32 to assure that the required temperature levels are achieved. In some cases the probes can be read directly, although preferably they are connected by wires or wireless means to a console, so that all probes can be monitored conveniently and the data recorded in real time.

At least one ingress duct and when the enclosure is sealed at least one egress duct are then installed as indicated in block 34. Generally, a plurality of ingress ducts is preferred. Although each duct may enter the enclosure separately, the use of one ingress entry duct connected to a manifold from which plural ducts extend to predetermined locations within the enclosure is preferred. When filtering the exiting gas, ducts may enter through any suitable opening, such as an open window or door with the remainder of the window or door blocked by a panel.

When everything is positioned, the gas (preferably air) is heated as indicated in block 36 and directed into the ingress duct(s), as indicated in block 38. If desired, ozone can be optionally added to the gas stream at this point, as indicated in block 40.

Air leaving through egress ducts may be filtered to remove the remains of the destroyed organisms, as indicated in block 42. The filter system will inherently impose some back pressure on the egress ducts and enclosure. Back pressure is desirable to assure surface exposure and penetration of the heated gas to all parts of the enclosure, but excessive back pressure should be avoided. Therefore, it is generally desirable that an air extraction system, as indicated in block 44, be included to increase air flow through the filter system and limit back pressure.

At any time during system operation, the ingress and egress ducts may be moved to assure uniform temperatures throughout the structure, as indicated by the temperature probes and temperature monitoring console.

Flow of the heated air through the enclosure will generally be continued for about 1 to 6 hours to provide optimum results. Usually the entire operation from preparation of the building to removal of the equipment will take six to eight hours.

While certain specific relationships, materials and other parameters have been detailed in the above description of preferred embodiments, those can be varied, where suitable, with similar results. Other applications, variations and ramifications of the present invention will occur to those skilled in the art upon reading the present disclosure. Those are intended to be included within the scope of this invention as defined in the appended claims.

What is claimed is:

1. A method for killing organisms and removing of toxic substances from an enclosure, which comprises the steps of:
  - preparing an enclosure having an interior and an exterior for exposure to a high temperature gas by removing or protecting all heat sensitive items;
  - positioning a plurality of temperature indicating probes at predetermined locations in said enclosure;
  - providing at least one ingress duct communicating with said interior of said enclosure and at least one egress duct communicating between said interior and said exterior of said enclosure;
  - directing said heated gas into said enclosure through said at least one ingress duct for a time sufficient to raise the temperature of said enclosure to said lethal temperature;
  - heating an environmentally acceptable gas to a temperature lethal to predetermined organisms;
  - monitoring the temperature from said probes;
  - recording said temperatures from said probes in real time;
  - establishing at least a slight positive pressure within said enclosure;
  - venting said heated gas from said enclosure; and
  - filtering air passing through said egress duct through a filter to remove remains of said organisms carried by said air.

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2. The method according to claim 1 further including the step of applying a vacuum to an outlet of said egress duct to aid in extracting gas from said enclosure through said filter.

3. A method for killing organisms and removing of toxic substances from an enclosure, which comprises the steps of:

preparing an enclosure having an interior and an exterior for exposure to a high temperature gas by removing or protecting all heat sensitive items;

positioning a plurality of temperature indicating probes at predetermined locations in said enclosure;

providing at least one ingress duct communicating with said interior of said enclosure;

heating an environmentally acceptable gas to a temperature lethal to predetermined organisms;

directing said heated gas into said enclosure through said at least one ingress duct for a time sufficient to raise the temperature of said enclosure to said lethal temperature;

monitoring the temperature from said probes;

recording said temperatures from said probes in real time;

establishing at least a slight positive pressure within said enclosure;

venting said heated gas from said enclosure; and

generating a predetermined quantity of ozone and adding said ozone to said heated gas in said ingress duct.

4. A kit for use in killing organisms and removing toxic substances from an enclosure, which comprises:

at least one ingress duct for directing gas into an enclosure and at least one egress duct for directing gas out of said enclosure;

a plurality of temperature indicating probes for installation at predetermined locations in said enclosure;

means for heating an environmentally acceptable gas to a predetermined temperature that is lethal to predetermined organisms;

means for directing said gas through said ingress duct;

means for viewing the temperatures of said indicating probes;

means for recording the temperatures of said indicating probes in real time;

means for removing remains of said organisms from said enclosure; and

filter means in said egress duct for removing remains of said organisms from gas from said enclosure passing through said egress duct.

5. A kit for use in killing organisms and removing toxic substances from an enclosure, which comprises:

at least one ingress duct for directing gas into an enclosure and at least one egress duct for directing gas out of said enclosure;

a plurality of temperature indicating probes for installation at predetermined locations in said enclosure;

means for heating an environmentally acceptable gas to a predetermined temperature that is lethal to predetermined organisms;

means for directing said gas through said ingress duct;

means for viewing the temperatures of said indicating probes;

means for recording the temperatures of said indicating probes in real time;

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means for removing remains of said organisms from said enclosure; and

means for generating ozone and adding said ozone to said gas passing through said ingress duct.

6. A method for sanitizing an enclosed structure having an exterior and an interior, comprising the steps of:

preparing said enclosed structure for exposure to a high temperature gas by removing or protecting all heat sensitive items;

disposing a plurality of temperature indicating probes at predetermined locations within said enclosed structure;

heating a gas to a predetermined temperature;

directing said heated gas into said enclosed structure in order to raise the temperature within said enclosed structure to said predetermined temperature;

monitoring the temperature detected from said probes in real time to ensure that all portions of said enclosed structure reach said predetermined temperature;

venting said heated gas from said enclosed structure; and filtering said heated gas vented from said enclosed structure.

7. A method for sanitizing an enclosed structure having an exterior and an interior, comprising the steps of:

preparing said enclosed structure for exposure to a high temperature gas by removing or protecting all heat sensitive items;

disposing a plurality of temperature indicating probes at predetermined locations within said enclosed structure;

heating a gas to a predetermined temperature;

generating a predetermined quantity of ozone and adding said ozone to said heated gas;

directing said heated gas into said enclosed structure in order to raise the temperature within said enclosed structure to said predetermined temperature;

monitoring the temperature detected from said probes in real time to ensure that all portions of said enclosed structure reach said predetermined temperature; and venting said heated gas from said enclosed structure.

8. A system for sanitizing an enclosed structure having an exterior and an interior, comprising:

a source of an environmentally acceptable gas;

a heater coupled to said gas source to heat said gas to a predetermined temperature, and means for introducing a flow of said heated gas into said interior of said enclosed structure;

a filter arranged to allow said flow of heated gas to pass therethrough after passing through said interior of said enclosed structure;

a plurality of temperature indicating probes adapted to be disposed at predetermined locations within said enclosed structure; and

a control unit electrically connected to said plurality of temperature indicating probes to thereby provide an indication of temperature at said predetermined locations within said enclosed structure;

wherein, said heated gas serves to kill organisms and remove toxic substances from within said enclosed structure.

\* \* \* \* \*

**U.S Patent 6,327,812    Method of Killing Organisms and Removal    Issued: 12/11/2001**  
**Of Toxins in Enclosures**

This patent, assuming that all maintenance fees are paid during the life of the patent, will have an effective term which will expire on May 28, 2019.

This patent is directed to a method and kit of components for destroying organisms and toxins from an enclosed structure utilizing elevated air temperatures. It is alleged that the increased temperatures are sufficient to kill all insects, bacteria, virus, dust mites, spiders, silver fish, fungi and toxic molds as listed.

The application acknowledges U.S. Patent 4,817,329 to Forbes for exterminating wood destroying insects by applying a heated gas to the wooden surfaces of the building, typically in a range of from 120 to 135 degrees, effectively killing the termites. The patent further goes on to indicate that the Forbes method is not effective for other organisms such as fungi and toxic molds such as those listed.

The '812 patent allegedly improves upon the Forbes '329 patent by utilizing temperature indicating probes within the building in communication with a recording device to monitor the temperatures within the building. Further alleged improvement is to include a quantity of ozone to be fed into the building with the heated air which aid in the killing of organisms and will eliminate chemical fumes and odors. Another alleged improvement is to include a vacuum extraction system in the egress ducts from the building to aid in captured the exterminated organisms in a filter media.

The application contains eight independent claims. Independent Claim 1 is directed to a method for killing organisms and removing of toxic substances from enclosures, which includes the steps of 1) preparing the enclosure having an interior and exterior for exposure to high temperature gas by removing or protecting all heat sensitive items; 2) positioning a plurality of temperature indicating probes at predetermined locations within the enclosure; 3) proving at least one ingress duct communicating with the interior of the enclosure and one egress duct communicating between the interior and the exterior of the enclosure; 4) directing heated gas into the enclosure through the ingress duct for a time sufficient to raise the temperature of the enclosure to a lethal temperature; 5) monitoring the temperature from said probes; 6) recording the temperatures from said probes in real time; 7) establishing at least a slight positive pressure within the enclosure; 8) venting said heated gas from the enclosure; and 9) filtering air passing through the egress duct through a filter to remove the remains of any organisms carried by the air.

Independent Claim 3 is identical to independent Claim 1 with the exception that it calls for generating a predetermined quantity of ozone and adding this to the heated gas in the ingress duct.

Independent Claim 4 is identical to independent Claim 1, except is directed to a kit for use in killing organisms, as opposed to a method.

Independent Claim 5 is identical to independent Claim 1 with the exception that it is directed to a kit for killing organisms and calls for the generation of ozone in the ingress duct. Independent

Claim 6 is identical to independent Claim 1 with the exception that it is characterized as a method for sanitizing an enclosed structure.

Independent Claim 7 is identical to independent Claim 1, except for the fact that it is indicated as a method for sanitizing an enclosed structure utilizing ozone in the incoming gas.

Independent Claim 8 is identical to independent Claim 1, except it is characterized as a system for sanitizing an enclosed structure.

The only difference between the '812 patent and the original Forbes '329 patent is the use of temperature probes and recording devices, the inclusion of ozone in the ingress air and the use of a vacuum to remove air from the dwelling in accompaniment with a filter means.