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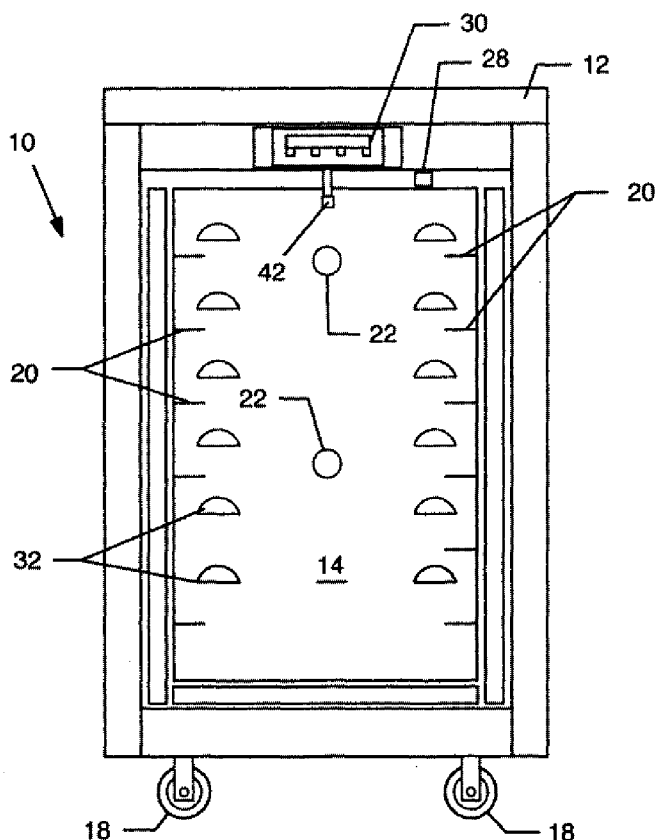
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(54) Title: METHOD FOR DECONTAMINATING OBJECTS CONTAMINATED WITH HARMFUL BIOLOGICAL AGENTS



(57) Abstract: A portable decontamination unit includes a portable housing which defines an interior sealable cavity accessible through a door. An inlet and an outlet are provided through the housing for introducing heated air into and removing the heated air from the cavity. A temperature sensor is positioned within the cavity for monitoring the temperature of the cavity and its contents, and an electronic display is provided of the temperature within the cavity over time. An ultraviolet lamp or other radiating device is positioned within the cavity for irradiating objects to be decontaminated with irradiating waves. An air scrubber is associated with the outlet, and fans are associated with both the inlet and outlet to condition air being forced into and extracted from the cavity.

METHOD FOR DECONTAMINATING OBJECTS CONTAMINATED WITH HARMFUL BIOLOGICAL
AGENTS
DESCRIPTION

BACKGROUND OF THE INVENTION

[Para 1] The present invention generally relates to devices for sanitizing and decontaminating objects. More particularly, the present invention relates to an apparatus for killing and removing bacteria, mold, viruses, and other harmful organic substances from objects which have become contaminated, or which may be contaminated.

[Para 2] Very recently the threat of bioterrorism has been realized in that letters, other packages, and/or personal items containing anthrax have been sent to high profile media personnel and government officials. Many postal workers, mail room clerks, secretaries and others have become infected, and some have even died due to the exposure of the anthrax from such packages. Unfortunately, it has been found that not only those coming into contact with the package itself, but others that are in the proximity of the package have become infected as the dust or residue on or within the package has leaked and contaminated other objects and areas around the package. Understandably, there has been a great concern and need to decontaminate letters, packaging or personal items delivered through the mail, and in the event that a building has been contaminated, the decontamination of objects within the building to prevent further exposure and disease caused by such biological agents or allergens.

[Para 3] Thus, there is a need for a portable apparatus for treating letters and packages delivered through the mail or received by courier, and for decontaminating other objects within a structure which may otherwise be difficult to decontaminate utilizing standard

chemical and biohazard decontamination techniques. It will be appreciated that if the letters and packages are first decontaminated or treated before being delivered, the risk of exposure to anthrax or other bioterrorism agents will be significantly reduced. The present invention fulfills these needs and provides other related advantages.

BRIEF DESCRIPTION OF THE DRAWINGS

[Para 4] The accompanying drawings illustrate the invention. In such drawings:

[Para 5] FIGURE 1 is a front elevational view of a portable decontamination unit employed in the present invention, wherein a front wall having doors has been removed to show the interior of the decontamination unit; and

[Para 6] FIGURE 2 is a side elevational view of the portable decontamination unit of FIG. 1.

SUMMARY OF THE INVENTION

[Para 7] The present invention resides in a portable decontamination unit useful in destroying harmful biological agents in contaminated objects. The portable decontamination unit of the present invention permits a large quantity of mail and other objects to be effectively treated in a relatively short amount of time, all within a unit that can be moved to locations where it is needed most.

[Para 8] In a preferred form of the invention, the portable decontamination unit comprises a portable housing which defines an interior sealable cavity accessible through a door. An inlet is provided for introducing heated air into the cavity, and an outlet is provided for removing air from the cavity. A temperature sensor is provided within the

cavity for monitoring the temperature of the cavity and its contents. Further, an electronic display permits monitoring of the temperature within the cavity over time.

[Para 9] In one form of the invention, wheels are associated with the housing to facilitate movement of the decontamination unit from one location to another. A perforated baffle is disposed within the cavity of the housing through which heated air passes. An ultraviolet lamp is also positioned within the cavity for irradiating objects to be decontaminated with ultraviolet light. Moreover, the electronic display includes a printer.

[Para 10] Means are provided for supporting objects to be decontaminated within the cavity of the housing. The supporting means may comprise a shelf which includes a pair of oppositely facing brackets fixed to interior surfaces of the housing. Further, the supporting means may include a rod within the cavity which enables the hanging of objects thereon.

[Para 11] Means are associated with the inlet, for introducing heated air into the cavity under positive pressure. Such introducing means may comprise a fan or similar device. Means are also associated with the outlet, for extracting air from the cavity. The extracting means may comprise an exhaust fan. Further, an air scrubber, such as high efficiency particulate arrestance (HEPA) and carbon filters, is provided to remove the remains of biologic organisms from exhaust air and to prevent them from reaching the environment.

[Para 12] In accordance with the present invention, the method for decontaminating objects contaminated with harmful biological agents, such as mail articles, including at least one of letters, postcards, and packages, comprises the steps of providing a portable decontamination unit having a housing defining an internal cavity accessible through a door. The decontamination unit may have wheels disposed thereon to facilitate movement of the decontamination unit. Air within the housing is heated to a temperature of between 130°F and 400°F, and more preferably between 300°F and 400°F. The temperature is monitored and maintained within the housing for a predetermined time. In the case of

suspected contamination of deadly microorganisms, the temperature is maintained between 300°F and 400°F for several hours, such as at least 8 hours.

[Para 13] A negative pressure is created and maintained within the housing by extracting air from the housing through an air scrubber. Such may be done by disposing a vacuum device relative to an outlet of the housing for extracting air from the housing and through the air scrubber.

[Para 14] In a particularly preferred embodiment, the contents of the housing are irradiated, such as with ultraviolet light from an ultraviolet lamp disposed within the housing.

[Para 15] Means for supporting objects to be decontaminated within the cavity are provided, including at least one of a rod or shelf including a pair of oppositely facing brackets fixed to interior surfaces of the housing. The condition of the objects within the housing is preferably visually monitored during the decontamination process. The monitoring step may also include the step of providing an electronic display of the temperature, and placement of temperature probes within the housing and in or adjacent to the objects to be decontaminated. The temperature of the housing over time may be printed using a printer operably connected with the decontamination unit.

[Para 16] In a particularly preferred embodiment, biocides are introduced into the housing either during the decontamination process, or placed within the decontamination unit with the objects to be decontaminated before the decontamination process begins. Preferably, biocides are selected which have a synergistic effect with heat or radiation. The heated air is introduced, such as through an inlet in the perforated battle of the housing, and the biocides may be introduced simultaneously. The combination of biocides and heat and/or radiation (including radiowaves) creates a synergistic effect such that less biocide material is required to effectively decontaminate the objects.

[Para 17] Other features and advantages of the present invention will become apparent from the following more detailed description, taken in conjunction with the accompanying drawings which illustrate, by way of example, the principles of the invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[Para 18] As shown in the drawings for purposes of illustration, the present invention resides in a portable decontamination unit, generally referred to by the reference number 10, which destroys harmful organic agents such as microbiological, bacterial and viral agents, from objects which have been contaminated.

[Para 19] With reference to FIGS. 1 and 2, there is shown an exemplary portable decontamination unit 10 having a housing 12 which defines an interior cavity 14 accessible through one or more doors 16. Preferably, the housing 12 is comprised of stainless steel so as to be durable, capable of withstanding high temperatures, as well as capable of being sanitized quite easily. The unit 10 shown is 31.625 inches wide, 71.187 inches tall, and 33.00 inches deep. It should be understood, however, that the unit 10 can be of various sizes, configurations and portability. For example, the unit 10 may be larger or smaller to accommodate the needs of the objects to be decontaminated. For example, the unit 10 may be sized so as to fit within a van or on a trailer so as to be transported from site to site. Although the edges of the illustrated unit are relatively square and sharp, preferably the edges of the unit 10 are rounded to provide greater safety to the users thereof.

[Para 20] The unit 10 shown is portable, and as such includes wheeled casters 18 to facilitate movement of the unit 10. The unit 10 may be incorporated into a trailer, or it may also be built in a fixed unit configuration.

[Para 21] The housing 12 and doors 16 cooperatively seal the enclosure 14. High quality gaskets are installed around the doors 16 in the unit 10 to control the ingress and egress of gas (air) with a complete and secure seal. This renders the unit 10 safer and more efficient to use by not allowing heat or biologics to escape and contaminate the surrounding environment. Preferably, a glass window is installed in each door 16 to observe the contents during the heating cycle process. This allows the operator to monitor the condition of the contents.

[Para 22] The interior of the housing preferably includes several "L" brackets 20 which serve as shelves for placing trays of objects therein, such as trays of letters, packages, etc. Tubes or rods 22 preferably extend into the cavity 14 to enable the hanging of other objects therein. Preferably, fans are installed inside of the unit 10 to create air turbulence. This forced movement of air in the unit 10 may increase the heat penetrative capability of the process and provide for even more heating. Also, means for introducing humidity into the cavity 14, such as a nebulizer, bath of water in the base of the unit 10, etc. is preferably provided as moisture can provide greater penetrative capability for certain biological contaminants. The addition of humidity may also allow the inactivation of contaminants at lower temperatures.

[Para 23] The unit 10 includes inlet and outlet ducts 24 and 26 for introducing and removing air. The unit 10 may include an internal heater, or heated air may be introduced through inlet 24 and removed from outlet 26. Preferably, a vacuum device or blower is installed at the outlet duct 26 for removing air from the unit 10 and creating a negative pressure within the internal cavity of the unit 10. In some applications, a cooler may be included to more quickly cycle contents of the unit 10 through the decontamination procedure described below, and to help maintain an acceptable ambient temperature around the unit 10.

[Para 24] Most bacteria are destroyed at 130° F after being exposed to this temperature for thirty minutes or more. However, it has been found that the anthrax spore requires temperatures in excess of 248° F for thirty minutes or more in order to be completely destroyed. The Department of Defense of the United States has identified the thirteen most probable bio-hazardous organisms and materials. All of them can be neutralized within the portable decontamination unit 10 of the present invention, at an internal temperature of 320° F for 8–12 hours. Air is heated to a temperature that is lethal to the organism to be destroyed. Thus, for complete disinfection, the air temperature is raised to at least 248° F to kill the anthrax spores. When the objects are suspected of being contaminated with microorganisms which are deadly, the air is heated to a temperature of between 300°F and 400°F for at least eight hours to ensure complete disinfection. It has been found that the flash point of letters and packaging is in excess of 400° F. Objects, such as mail, personal belongings, etc., placed within the cavity 14 will not be significantly damaged by temperatures well below their flashpoint.

[Para 25] The unit 10 includes one or more temperature sensors and/or probes 28, (fixed or portable) to monitor the internal temperature of the cavity 14 and its contents. A display 30 informs the user of the unit 10 of the temperature, time, etc. It is contemplated that temperature probes 28 could be used and placed within the letters and packaging to ensure that the proper temperature is attained throughout all of the objects to be decontaminated. Such probes could be wired into the display 30. Preferably, the display 30 comprises a digital readout that is constructed into the unit 10. This display 30 may include a printer, or be connected to a printer, for printing out the internal cavity 14 temperature over time. This provides users of the unit 10 documentation of maintaining the lethal temperature for the required time.

[Para 26] In use, objects to be decontaminated, such as mail, are placed within the cavity 14 and the doors 16 locked so as to seal the cavity 14. Air heated in excess of 130° F is introduced through the inlet 24 with a positive air pressure using a blower or the like. The air enters into the cavity 14 through a perforated baffle 32. Preferably, the air is circulated using fans 34 or the like, although due to the size of the unit 10 the introduction of the air through the inlet 24 is probably sufficient to ensure an overall consistent temperature within the cavity 14.

[Para 27] Biocides are preferably introduced into the internal cavity of the unit 10. This may be done, for example, by placing the biocides within the internal cavity when the contaminated objects are placed within the unit 10. Alternatively, the biocides are injected, such as through the inlet duct with the heated air, during the decontamination process. A variety of biocides can be used depending upon the suspected contaminants. For example, the biocides may include zinc oxide, borates, orange oil, hydrogen peroxide, diatomaceous earth, dessicants, methyl bromides, fumigants, pesticides, chlorine dioxide, copper napinate, bleach, detergents, Vikne™, MDF-500, MILGO QGC or Microban QGC, both manufactured by IIRep-Z Inc. It has been found that the use of biocides in conjunction with heated air has a synergistic effect in that less biocides need to be added to the cavity 14 to complete decontamination. For example, simply applying a biocide alone at a lower temperature requires more biocide than if the cavity 14 is heated to the temperature range disclosed herein. Furthermore, some biocides, particularly metallic-based biocides, can have a positive synergistic reaction with radiation, such as ultraviolet wave lengths. As discussed more fully herein, this can also be advantageously used in decontaminating the objects.

[Para 28] The heated air is preferably passed through an air scrubber 36, such as high efficiency particulate arrestance (HEPA) and carbon filters, to remove the remains of the

organisms from the air and to prevent them from reaching the environment. Other filters 36 such as UV filters may be employed as well. It has been found that mail gives off volatile organic compounds (VOC), which can be toxic. Also, certain biologic bodies may pose a health risk, in the form of allergens, even when inactivated. The VOC's given off by plastic components and resins of the mail, and inactivated biological bodies will be removed by a filtration system 36. For optimum effectiveness, it is often desirable to increase air flow rates by adding a vacuum device 38, such as a blower, in association with the air scrubber to aid in the extracting of the air from the unit 10. The force of extraction also increases the efficiency of filtering of the air by the air scrubber. Air flow ports may be installed in the unit 10 to control or make up air for negative air flow into the cavity 14. This provides the operator of the unit 10 greater control over heat and negative air flow.

[Para 29] Some organisms, such as anthrax spores, can be particularly difficult to completely destroy. Accordingly, the unit 10 preferably includes one or more ultraviolet light fixtures so that ultraviolet lamps 42 can direct ultraviolet light onto the objects to be decontaminated. It is well known that such ultraviolet light can serve to kill harmful organisms. In addition, biocides or fumigants may be injected or placed into the cavity 14, such as through the inlet 24, which synergistically react with the heated air to destroy the organisms.

[Para 30] After treating the objects for the predetermined temperature and time, the air is removed through the outlet 26 under negative pressure in order to facilitate the dislodgement of the contaminants from the objects and filtering them from the air which is discharged from the unit 10. In some instances, quickly cooling objects placed within the cavity 14 may desirably further decontaminate objects within the housing 12. This is accomplished by cooling the cavity 14 quickly from an elevated temperature so that the

target microbiological, bacterial and/or viral agents are unable to adjust to the change in temperature, thereby neutralizing them.

[Para 31] It will be appreciated that a large quantity of mail and other objects can be effectively treated in a relatively short amount of time using the unit 10 of the present invention. The invention can be used not only to decontaminate objects which have been known to be contaminated, but can also be used as a preventive measure in treating, for example, mail before it is delivered to avoid the possibility of contamination.

[Para 32] Although an embodiment has been described in detail for purposes of illustration, various modifications may be made without departing from the scope and spirit of the invention. Accordingly, the invention is not to be limited, except as defined in the following claims.

What is claimed is:

[Claim 1] A method for decontaminating objects contaminated with harmful biological agents, comprising the steps of:

providing a portable decontamination unit having a housing defining an internal cavity accessible through a door;

heating air within the housing to a temperature between 130 degrees and 400 degrees Fahrenheit;

monitoring and maintaining the 130 degrees and 400 degrees Fahrenheit temperature within the housing for a predetermined time; and

creating and maintaining a negative pressure within the housing by extracting air from the housing through an air scrubber.

[Claim 2] The method of claim 1, including the step of maintaining the temperature in the housing between 300 degrees and 400 degrees Fahrenheit.

[Claim 3] The method of claim 2, including the step of maintaining the temperature in the housing between 300 degrees and 400 degrees Fahrenheit for at least eight hours.

[Claim 4] The method of claim 1, including the step of irradiating contents of the housing.

[Claim 5] The method of claim 4, including the step of disposing an ultraviolet lamp or other radiating device within the housing.

[Claim 6] The method of claim 1, including the step of visually monitoring the condition of objects within the housing during the decontamination process.

[Claim 7] The method of claim 1, including the step of positioning a plurality of temperature probes within the internal cavity.

[Claim 8] The method of claim 1, wherein the monitoring step includes the step of providing an electronic display of the temperature.

[Claim 9] The method of claim 8, including the step of printing the temperature of the housing over time using a printer operably connected to the decontamination unit.

[Claim 10] The method of claim 1, wherein the providing step includes the step of disposing wheels on the decontamination unit to facilitate movement of the decontamination unit.

[Claim 11] The method of claim 1, wherein the creating and maintaining step includes the step of disposing a vacuum device relative to an outlet of the housing for extracting air from the housing and through the air scrubber.

[Claim 12] The method of claim 1, wherein the providing step includes the step of providing means for supporting objects to be decontaminated within the cavity of the housing.

[Claim 13] The method of claim 12, wherein the supporting means comprises at least one rod or a shelf including a pair of oppositely facing brackets fixed to interior surfaces of the housing.

[Claim 14] The method of claim 1, including the step of introducing biocides into the housing to facilitate decontamination of the objects.

[Claim 15] The method of claim 14, including the step of selecting biocides exhibiting improved effectiveness in the presence of elevated heat or radiation.

[Claim 16] The method of claim 1, including the step of introducing heated air through an inlet and a perforated baffle of the housing.

[Claim 17] The method of claim 1, including the step of inserting potentially contaminated objects into the housing cavity, the objects comprising mail articles including at least one of letter, postcards, and packages.

[Claim 18] A method for decontaminating objects contaminated with harmful biological agents, comprising the steps of:

providing a portable decontamination unit having a housing defining an internal cavity accessible through a door, wheels attached to the housing, a temperature display, and means for supporting the objects to be decontaminated within the housing;
heating air within the housing to a temperature between 300 degrees and 400 degrees Fahrenheit;
monitoring and maintaining the 300 degrees and 400 degrees Fahrenheit temperature within the housing for at least eight hours;
irradiating contents of the housing;
creating and maintaining a negative pressure within the housing by extracting air from the housing through an air scrubber; and
visually monitoring the condition of the objects within the housing during the decontamination process.

[Claim 19] The method of claim 18, including the step of disposing an ultraviolet lamp or other radiating device within the housing.

[Claim 20] The method of claim 18, including the step of printing the temperature of the housing over time using a printer operably connected to the decontamination unit.

[Claim 21] The method of claim 18, wherein the support means of the housing comprises at least one rod or a shelf including a pair of oppositely facing brackets fixed to interior surfaces of the housing.

[Claim 22] The method of claim 18, including the step of inserting potentially contaminated objects into the housing cavity, the objects comprising mail articles including at least one of letter, postcards, and packages.

[Claim 23] The method of claim 18, including the step of introducing biocides into the housing to facilitate decontamination of the objects.

[Claim 24] The method of claim 23, including the step of selecting biocides which hisibit increased effectiveness in the presence of elevated heat or radiation.

[Claim 25] The method of claim 18, including the step of introducing heated air through an inlet and a perforated baffle of the housing.

[Claim 26] The method of claim 18, including the step of inserting potentially contaminated objects into the housing cavity, the objects comprising mail articles including at least one of letter, postcards, and packages.

[Claim 27] The method of claim 18, including the step of positioning a plurality of temperature probes within the internal cavity of the housing.

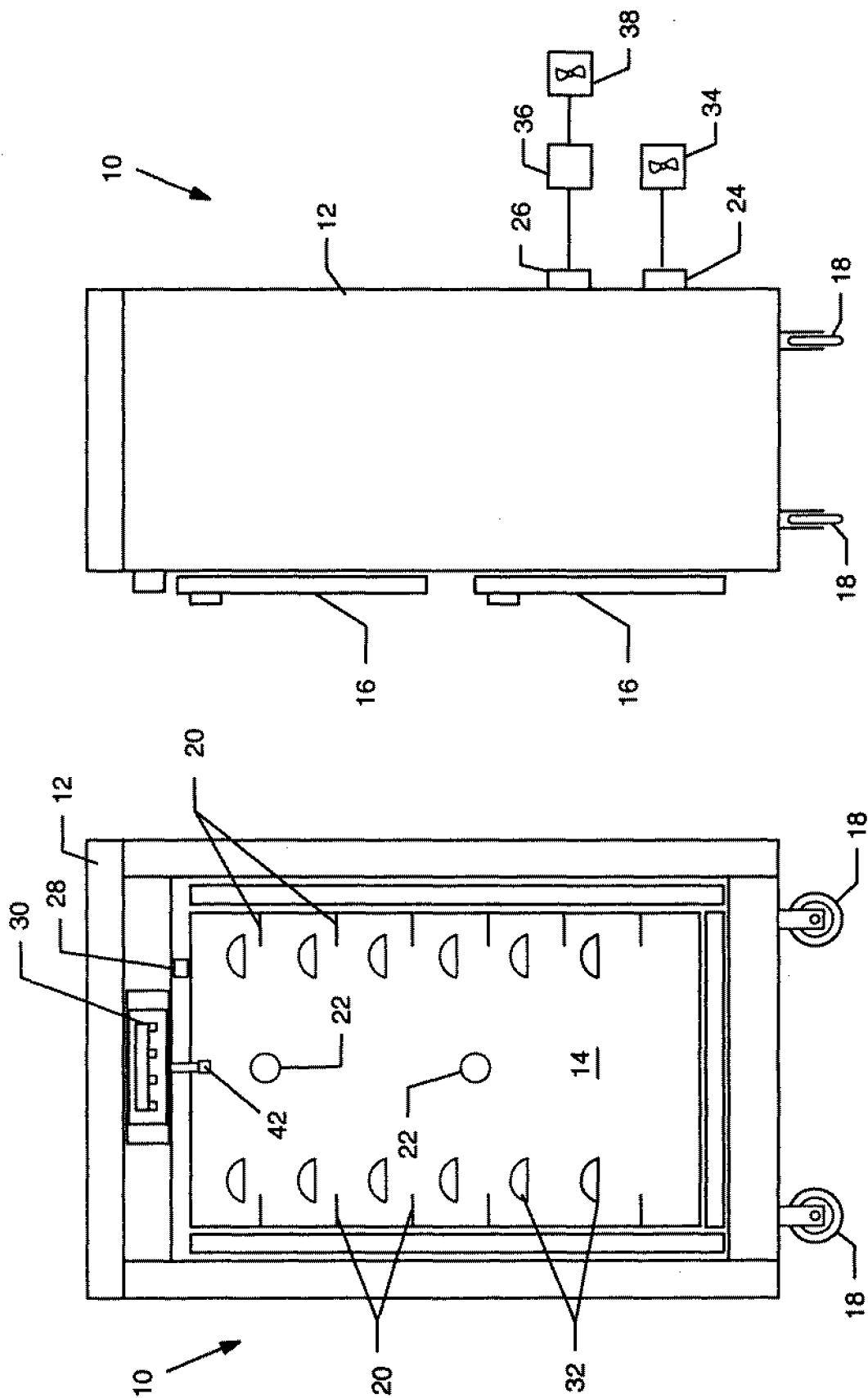


FIG. 2

FIG. 1