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Inventor(s)	Patton; James et al.

APPARATUS, SYSTEM, AND METHOD FOR DISINFECTING AND SANITIZING OBJECTS USING OZONE AND HUMIDITY

Abstract

The subject matter of the present disclosure relates, in various embodiments, to an apparatus, system and method that provides a new and improved ozone treatment chamber that effectively and efficiently disinfects and sanitizes a multitude of target objects using locally generated ozone and humidity. The present invention comprises a housing unit, an ozone generator, a humidity generator, an ozone destructor and a control system for managing same. In alternate embodiments, in addition to the above structures, a heating system is provided to assist with drying if needed and/or to eradicate lice, bedbugs and their eggs. In use, the present invention disinfectants (at least a 3 log 10 or 99.9% reduction in virus titers) and sanitizes (at least a 3 log 10 or 99.9% reduction in bacterial count) a plurality of viruses and bacteria, respectively, thus eliminating the need for harsh chemical liquids.

Inventors: **Patton; James (Anderson, SC), Mann; Walter (Sandy Springs, GA), Patton; Joseph (Anderson,, SC)**

Applicant: **ZScience, LLC** (Johns Creek, GA)

Family ID: **1000008508017**

Assignee: **ZScience, LLC (Johns Creek, GA)**

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Background/Summary

PRIORITY CLAIM [0001] To the fullest extent permitted under applicable law, the present application claims priority to and benefit of U.S. Provisional Patent Application 63/556,266, filed on Feb. 21, 2024, entitled "Apparatus, System and Method for Disinfecting and Sanitizing Objects Using Ozone and Humidity," and said provisional patent application is incorporated herein by reference.

TECHNICAL FIELD
[0002] The subject matter of the present disclosure relates, generally, to apparatuses, systems, and methods for disinfecting and sanitizing various objects. More particularly, the subject matter of the present disclosure relates to an apparatus, system, and method for disinfecting and sanitizing objects using ozone and humidity.
BACKGROUND
[0003] Worldwide, bacteria and viruses cause an enormous economic, health, and emotional burden on society. More specifically, some of the most common and dangerous bacteria include *Staphylococcus aureus* (including MSRA), *Salmonella enterica*, *Escherichia coli* (*E-coli*), *Streptococcus pyogenes*, *Shigella dysenteriae*, and *Pseudomonas aeruginosa*. Bacterial infections, collectively, are considered one of the leading causes of death worldwide, resulting in approximately 7.7 million deaths per year and billions of dollars in health costs. Viruses, such as Covid-19, respiratory syncytial virus (RSV), norovirus, and influenza, likewise, also result in millions of deaths per year and billions of dollars in health costs. Not only are these viruses and bacteria an enormous burden to the healthcare system, they are also a tremendous burden to society due to lost productivity that results from the millions of people infected per year. Even more devastating, subjectively, is the enormous emotional and financial burden to the families adversely affected by viruses and bacteria.
[0004] One of the most common ways that viruses and bacteria can spread is via porous, non-porous, and semi-porous surfaces. Ultimately, this means that any object could potentially be a carrier for viruses and bacteria. In fact, depending on the type of surface, some viruses/bacteria may survive as little as a few hours, while others could survive as long as several months. For example, on dry non-porous hard surfaces, the influenza virus can survive up to 24 hours; whereas, the Norovirus could survive up to several days; and, whereas, *Shigella dysenteriae* could survive as long as several months. Ultimately, any environment wherein objects are in contact with humans can serve as a potential vessel for transmitting viruses and bacteria. Moreover, high-use environments having repeated multiple human interaction, such as childcare facilities, schools, sports, fitness facilities, and public safety departments, are at an even higher risk of spreading viruses and bacteria. For example, some studies have shown that more than 70% of toys in a childcare facility can be contaminated with potentially harmful bacteria and/or viruses. Consequently, to minimize these risks, there is a critical need to regularly disinfect and sanitize the various target items utilized in these environments.

[0005] Historically, harsh liquid chemicals such as chlorine, chlorine compounds, formaldehyde, glutaraldehyde, ortho-phthalaldehyde, alcohols, hydrogen peroxide, iodophors, peracetic acid, phenolics, and quaternary ammonium compounds have been utilized to sanitize and disinfect these at-risk objects. However, there are many disadvantages in using these harsh liquid chemicals. For example, most of these chemicals, especially after repeated use, will adversely affect the target object's structural integrity; thus, reducing its intended lifespan; and thereby, resulting in increased costs to replace the object. Additionally, because many of these liquid chemicals are harmful to both the person applying the chemical and to the end user, these chemicals must be utilized in lower concentrations, making them potentially less effective; and/or they must be rinsed/wiped; thus, resulting in additional waste by-products. Furthermore, even after rinsing and wiping, the use of these chemicals often results in a residue and strong unpleasant odor remaining on the target item. Moreover, the process of adequately sanitizing and disinfecting target items with these harsh chemicals is extremely labor intensive; thereby, resulting in additional labor costs and added exposure to personnel. Additionally, many of the chemicals are considered hazardous by OSHA and/or a hazardous waste by the EPA; thus, requiring additional controls for their use and disposal.
[0006] To eliminate many of these prior-art disadvantages in using harsh liquid chemicals for sanitizing and disinfecting objects found in high-use and high-risk environments, the method of using ozone to disinfect and sanitize target objects has seen a tremendous surge over the last few years and is expected to see continued exponential growth for many years to come. Ozone is a powerful oxidizing gas that can be formed from ambient air by use of electrical discharge or ultraviolet light, wherein ozone comprises 3 oxygen molecules (O.sub.3). The first use of the word “ozone” was in 1840, in a writing by the German chemist Christian Friedrich Schonbein (1799-1868). Seventeen years later, in 1857 the first ozone generator was manufactured in Berlin, by the German inventor Ernst Werner von Siemens (1816-1892), wherein ozone was used in an attempt to destroy microorganisms in water. Then, in 1873, Cornelius Benjamin Fox (1839-1922) experimentally confirmed the ability of ozone to eliminate microorganisms. In 1896, Nikola Tesla (1856-1943) was issued U.S. Pat. No. 568,177 for an “Apparatus for Producing Ozone,” wherein ozone was formed by use of a corona discharge ozone generator having charged metal plates to act on ambient air. Subsequently, in 1900, Nikola Tesla founded the “Tesla Ozone Co.” to manufacture and sell ozone generators for medical use.
[0007] Following multiple laboratory results showing the safe and effective use of ozone as a disinfectant (at least a 3 log 10 or 99.9% reduction in virus titers) and a sanitizer (at least a 3 log 10 or 99.9% reduction in bacterial count), ozone has been used since the early 1900's to treat drinking water. In fact, almost all bottled water today is treated with ozone. Additionally, in 2000, the U.S. Department of Agriculture approved the use of ozone for meats and poultry, and in 2001, the U.S. Food and Drug Administration (FDA) approved the use of ozone for other foods. The World Health Organization (WHO) also recognizes ozone, when used properly, as an effective sanitizer for bacteria such as *Staphylococcus aureus* (including MSRA), *Salmonella enterica, Escherichia coli* (*E-coli*), *Streptococcus pyogenes, Shigella dysenteriae*, and *Pseudomonas aeruginosa*, and as an effective disinfectant for viruses such as respiratory syncytial virus (RSV), norovirus, and influenza. Although more studies are necessary, proper exposure to ozone has also shown promising results on non-porous and semi-porous surfaces as against viruses from the coronavirus family including SARS-COV-2, which causes Covid-19.
[0008] Ozone in lower concentrations (i.e., less than 0.05 ppm) is considered safe for indoor use by OSHA and EPA. However, to achieve the 3 log.sub.10 reduction in virus titers and bacterial count, ozone must be at sustained levels much higher than 0.05 ppm; and, as such, for the purpose of disinfecting and sanitizing objects used in high-use environments, sealed ozone treatment chambers are typically utilized. Generally speaking, target objects to be sanitized and disinfected are placed within the sealed ozone treatment chamber, wherein an ozone generator is used to raise the ozone level within the chamber for a specified period of time and then, only after the ozone levels have

been reduced to safe levels, the chamber is opened and the target objects are removed for immediate reuse.

[0009] The use of ozone treatment chambers has a multitude of advantages in comparison to the method of using harsh liquid chemicals. One of the most beneficial advantages is that proper ozone treatment has proven to be more effective in the reduction of many viruses and bacteria as compared to using liquid chemicals. Additionally, because ozone is a gas, it is able to reach and treat cracks and crevices that liquid chemicals may not reach. Because ozone treatment chambers generate ozone locally from ambient air, there is no need to transport or store dangerous liquid chemicals. Additionally, during the ozone treatment process, attention from personnel is not required, and, after use, target objects are immediately ready to be reused with no wiping or drying necessary; thus, labor costs are substantially reduced. Ozone treatment chambers also do not require or generate waste product that must be properly handled and disposed of, such as wipes, towels, containers, and gloves. Unlike ozone treatment chambers, harsh liquid chemicals often leave residue and an unpleasant odor. Ozone treatment chambers, like the present invention, are also energy and resource efficient, wherein less than 1 oz of water is used and less than 3 cents cost of electricity is used per treatment cycle.

[0010] As a result of the recent Covid-19 pandemic, which to date has been attributed to approximately 7 million deaths, as many as 1 billion infections and a total societal cost of more than 100 trillion dollars, coupled with the millions of deaths and billions of dollars spent annually on other viral and bacterial infections, the use of ozone treatment chambers for sanitizing and disinfecting objects in high-use environments has seen tremendous growth and innovation. Consequently, ozone treatment chambers have become a necessary and effective tool for minimizing the enormous societal cost resulting from the exposure and resultant illnesses caused by a plurality of bacteria and viruses carried on everyday objects. As such, even minor improvements in this field can have a significant positive impact on both the overall health and financial welfare of society.

[0011] Although there have been many attempts to design efficient and effective ozone treatment chambers, there are many deficiencies in these designs. For instance, as studies have shown, the use of humidity, at optimal percentages and optimal duration (as discussed further below), have a significant positive impact on the effectiveness of ozone treatment by the enabling the production of hydroxyl radicals. Hydroxyl radicals (OH) are a highly reactive product of ozone decomposition. Managing ozone level and humidity is critical in the production of hydroxyl radicals. The hydroxyl radical (OH) is the major intermediate reactive responsible for organic substrate oxidation. Hydroxyl radicals are extremely reactive and react as soon as they are formed. Their lifetime is less than a second, and they damage the majority of organic compounds, including bacteria and virus. Ozone and water must be continuously supplied at their optimum levels to generate hydroxyl radicals to the required levels for disinfection and sanitization.

[0012] However, some prior designs fail to incorporate the use of humidity and/or fail to provide a sufficient duration and combination to adequately disinfect and sanitize. In addition to the duration of treatment, it is also critical that the level of ozone in terms of parts per million (ppm) be high enough to effectuate the desired result. Failure to meet either these requirements (ppm or duration of treatment) could result in inadequate reduction (99.9%) of the applicable viruses and bacteria. Even though there have been attempts in prior designs to incorporate humidity into their treatment process, they fail to properly manage the humidity levels, wherein, for example, the objects to be sanitized/disinfected already have a high level of moisture content such as used sporting equipment, uniforms, personal protective equipment (PPE), and/or the like. Moreover, many prior designs also fail to remove moisture through a heating phase as may be needed for these types of items. Additionally, prior ozone treatment chamber designs fail to adequately couple a managed ozone treatment with a sufficient heat phase to effectively eradicate bed bugs, lice, and their eggs. It should also be noted that prior designs also fail to provide an easy means for the user to add

additional water and/or to repair or replace the moisture generating means.
[0013] Another deficiency seen in prior attempts is their inability or inefficiency in converting ozone back to oxygen. More specifically, the high levels of ozone needed to adequately disinfect and sanitize is harmful to humans and animals. Consequently, to reduce this risk, additional time must be added to the treatment process to allow ozone to naturally decay to oxygen and/or use an ozone destructor to speed up this process. To facilitate same, various sensors must be incorporated to ensure that the level of ozone inside the chamber is at the optimal level during use and that, prior to opening the chamber, the level of ozone has been reduced to safe levels. Some prior attempts fail to provide adequate ozone destruction; thus, increasing the amount of time needed prior to the opening of the ozone treatment chamber. Additionally, some prior attempts fail to adequately detect ozone levels outside of the chamber; thereby, potentially failing to discover potential leaks. As another deficiency, unlike the present invention, some prior designs also fail to seal the inside of the chamber to further reduce the risk of high-level ozone exposure.
[0014] Consequently, as can be seen, there is a need for an apparatus, system, and method for disinfecting and sanitizing objects used in high-use environments that delivers an adequate means for providing and managing ozone exposure, humidity levels, ozone destruction, and heat cycles in a safe and efficient manner to provide adequate disinfection and sanitization of various viruses and bacteria, respectively. Accordingly, it is to the disclosure of such an apparatus, system, and method that the following is directed.
SUMMARY
[0015] The subject matter of the present disclosure relates, in various embodiments, to an apparatus, system, and method that solves the above-discussed deficiencies by providing a new and improved ozone treatment chamber that effectively and efficiently disinfects and sanitizes a multitude of target objects.
[0016] According to some embodiments, the present invention broadly comprises a housing unit, an ozone generator, a humidity generator, an ozone destructor, and a control system for managing same. In alternate embodiments, in addition to the above structures, a heating system is provided to assist with drying if needed and/or to eradicate lice, bed bugs, and their eggs.
[0017] A feature and benefit of the present invention is its ability to disinfectant (at least a 3 log.sub.10 or 99.9% reduction in virus titers) and sanitize (at least a 3 log 10 or 99.9% reduction in bacterial count) a plurality of viruses and bacteria, respectively; thus, eliminating the need for harsh chemical liquids. Consequently, less waste such as wipes, towels, gloves, and containers are generated.
[0018] Another feature and benefit of the present invention is its ability to locally generate ozone gas from ambient air at an extremely low energy consumption per treatment.
[0019] Another feature and benefit of the present invention is its ability to generate humidity in combination with ozone gas to allow for a more thorough and efficient means of disinfecting and sanitizing objects that could potentially carry viruses and bacteria.
[0020] Another feature and benefit of the present invention is the use of a piezo mister to add humidity to an ozone treatment, coupled with a hinged cage to facilitate the ease of adding water and/or replacing the piezo mister without the need for tools.
[0021] Another feature and benefit of the present invention is its ability to rapidly convert ozone back to oxygen via a catalyst; thereby, reducing the cycle time needed to reach safe levels of ozone.
[0022] Another feature and benefit of the present invention is a control system that utilizes multiple sensors and safety features to ensure safe use. More specifically, the following is included in a preferred embodiment: a sweep button to ensure the inside chamber is clear of humans or other animals prior to starting; a magnetic lock that ensures the chamber cannot be opened until safe ozone levels have been reached; internal sensors to ensure the proper level of ozone and humidity are present during treatment and that after treatment, safe levels of ozone levels are achieved prior to allowing user to open the chamber; external sensors to detect possibility of ozone leakage and

exterior level of humidity; and viewing windows/ports to further confirm that no human or other animal are inside during treatment.
[0023] Another feature and benefit of the present invention is the use of rolling trays or carts that allow a multitude of objects to be simultaneously sanitized and disinfected; thus, substantially reducing labor intensive operations as required with liquid cleaners such as spraying, hand wiping, and drying of each individual object.
[0024] Another feature and benefit of the present invention is an easily refillable water tray; thus, eliminating the need to connect the present invention to a water source/line; and, thereby, allowing the present invention to be truly mobile and usable in a multitude of applications and environments.
[0025] Another feature and benefit of an alternate embodiment of the present invention is the use of one or more mesh filters to facilitate the evaporation of water, coupled with the ease of changing the filters, without the need for tools.
[0026] Another feature and benefit of some alternate embodiments of the present invention is the addition of a heating phase, wherein objects having high moisture content such as sporting equipment, uniforms, PPE, and/or the like may be dried to further ensure safe use. Additionally, the heating phase can also be used in combination with ozone treatment to eradicate lice, bed bugs, and their eggs.
[0027] These, and other features, advantages, and benefits shown by the various embodiments of the present subject matter, and related processes for creating them, as set forth within the present disclosure, will become more apparent to those of ordinary skill in the art after review of the following Detailed Description of Illustrative Embodiments and Claims in light of the accompanying drawing Figures.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0028] Accordingly, the within disclosure will be best understood through consideration of, and with reference to, the following drawing Figures, viewed in conjunction with the Detailed Description of Illustrative Embodiments referring thereto, in which like reference numbers throughout the various Figures designate like structure, and in which:
[0029] FIG. **1**A depicts a front view of the preferred embodiment of the present invention, shown in a closed position, in accordance with the subject matter of the present disclosure;
[0030] FIG. **1**B depicts a front view of the preferred embodiment of the present invention, shown in an open position, in accordance with the subject matter of the present disclosure;
[0031] FIG. **1**C depicts a top perspective view of the preferred embodiment of the present invention shown in a closed position, in accordance with the subject matter of the present disclosure;
[0032] FIG. **1**D depicts a perspective view of the preferred embodiment of the present invention shown in an open position wherein the doors have been removed, in accordance with the subject matter of the present disclosure;
[0033] FIGS. **2**A-**2**C, inclusive, depict views of the ozone generating system of the preferred embodiment of the present invention in accordance with the subject matter of the present disclosure;
[0034] FIGS. **3**A-**3**B, inclusive, depict views of the humidity generating system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0035] FIGS. **3**C-**3**E, inclusive, depict perspective views of the humidity generating system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;

[0036] FIG. **3**F depicts a perspective view of the humidity generating system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0037] FIGS. **4**A-**4**D, inclusive, depict perspective views of the humidity generating system of an alternate embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0038] FIG. **4**E depicts a perspective view of the humidity generating system of an alternate embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0039] FIGS. **5**A-**5**E, inclusive, depict views of the ozone destruction system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0040] FIG. **6** depicts a view of part of the control system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0041] FIG. **7**A depicts a view of a sensor of a control system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0042] FIG. **7**B depicts a view of the sensor of the control system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0043] FIG. **8** depicts a view of the PLC wiring connections for the control system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0044] FIG. **9** depicts a view of the expansion module one wiring connections for the control system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure;
[0045] FIGS. **10**A-**10**B, inclusive, depict front views of an alternate embodiment of the present invention showing in the closed position and in the open position, in accordance with the subject matter of the present disclosure; and
[0046] FIG. **11** depicts a view of a heating system of a preferred embodiment of the present invention, in accordance with the subject matter of the present disclosure.
[0047] It is to be noted that the drawing Figures presented are intended solely for the purpose of illustration and that they are, therefore, neither desired nor intended to limit the inventive subject matter to any or all of the exact details of construction shown, except insofar as they may be deemed essential to the claimed invention.

DETAILED DESCRIPTION OF ILLUSTRATIVE EMBODIMENTS

[0048] In describing the several embodiments illustrated in the Figures, specific terminology is employed for the sake of clarity. The inventive subject matter, however, is not intended to be limited to the specific terminology so selected, and it is to be understood that each specific element includes all technical equivalents that operate in a similar manner to accomplish a similar purpose. Additionally, in the Figures, like reference numerals and like description shall be used to designate corresponding elements, parts, and functionality throughout the several Figures.
[0049] Turning now to the FIGS. **1-10** generally, and more specifically to FIGS. **1**A-**1**D, inclusive, the preferred embodiment of the present invention **10**, comprises a housing unit **20**, an ozone generation system **60**, a humidity generation system **80**, an ozone destruction system **120**, and a control system **160**. In alternate embodiments, the present invention **10** further comprises a heating system **250**.
[0050] Housing unit **20** is generally rectangular shaped and comprises a floor member **22**, a rear wall **24**, a first side wall **26**, a second side wall **28**, an upper member **30**, a first door **40**, and a second door **42**, wherein said members are connected to define a closeable chamber **25** therebetween. Chamber **25** is a treatment area in which target items (not shown) are placed to be disinfected/sanitized/heated. Housing unit **20** has attached thereon ozone generation system **60**, a

humidity generation system **80**, an ozone destruction system **120**, and a control system **160**, wherein in a preferred embodiment, said systems are carried by upper member **30** of housing unit **20**.

[0051] Additionally, in embodiments utilizing a heating system **250**, housing unit **20** also carries said heating system **250**. Best seen with reference to FIG. **11**, heating system **250** preferably utilizes 120 volt, 1440 watt resistance heating elements **252**, in association with circulating blower **254**. Heating system **250** typically mounts to the left of the engine, above the plenum, in a 2-door embodiment, and in the bottom of a cart for a single door machine embodiment. In a 2-door embodiment, there is a rectangular hole in the rear of heating system **250** that directs and feeds air into the plenum. There is no need for a plenum-mounted heating system in a single door embodiment, because warm air rises and does not require further forced circulation. It is further noted, operationally, that it is undesirable to run the heater during an ozone cycle, because temperature changes impact the inside ozone sensor readings. This preference is enabled via the control system **160** discussed further hereinbelow.

[0052] It is contemplated in alternate embodiments that said systems could also be attached to and carried by floor member **22**, rear wall **24**, first side wall **26**, and/or second side wall **28**. First door **40** and second door **42** are attached to upper member **30** and floor member **22** via hinges **48**, wherein first door **40** and second door **42** are dimensioned to seal chamber **25** when closed. In the preferred embodiment, the sealing of first door **40** and second door **42** is via a mechanical fit utilizing one or more PVC magnetic gasket affixed around the perimeter of each door; however, in alternate embodiments it is contemplated that other known sealing means may be utilized. In this way, the chamber is essentially air tight. A lip **43** extends from second door **42** such that second door **42** is closed first and then first door **40** is closed to rest over lip **43**, wherein when locked, second door **42** cannot be opened without first opening first door **40**.

[0053] As will be described in more detail below in the discussion of control system **160**, a magnetic lock **178** and an armature **179** are provided to secure first door **40** and second door **42** in a closed and locked position during a treatment cycle and until control system **160** determines that ozone levels are at a safe level for the user to open same. First door **40** and second door **42** each further comprise a viewing window **44** to allow a user to see within chamber **25** during operation to further ensure that no human or other animal is therein. Viewing window **44** preferably extends a substantial length of first door **40** and second door **42** to assist a user in visual inspection of the entire chamber **25** area prior to use.

[0054] As will also be discussed in further detail below, an interior emergency stop button **165** is attached to the interior of first door **40** and in electronic communication with control system **160**; wherein, in the unlikely event a person is inside chamber **25**, said person can push said interior emergency stop button **165** to immediate shut down operation and unlock magnetic lock **178** to allow first door **40** to be opened. Similarly, an exterior emergency stop button **163** is attached to the exterior of first door **40** and in electronic communication with control system **160**, wherein a user can push said exterior emergency stop button **163** to immediate shut down operation and unlock magnetic lock **178** to allow first door **40** to be opened.

[0055] Loss of power will disable the magnetic door lock. As well, depressing an emergency stop button will unlock the door(s), regardless of ozone concentration, and will run the destructor for a predetermined minimum of 10 minutes. If power is lost during a cycle, then the doors will unlock; however, ozone decay will only occur naturally and through incidental exposure to the catalyst.

[0056] Attached to the exterior of first door **40** is handle **45** to allow a user to open same upon completion of a cycle or to load target items. In preferred embodiments, if the doors are left unlocked for more than 10 minutes while the machine is turned on, then a warning buzzer will chime until doors are locked or until the machine is turned off.

[0057] Also attached to the exterior of first door **40** is control panel **162** of control system **160**, wherein control panel **162** will be discussed further below. Although in the preferred embodiment armature plate **179**, control panel **162**, handle **45**, interior emergency stop button **165**, and exterior emergency stop button **163** are carried by first door **40**, it is contemplated that some or all of said items could be carried by second door **42**. In the event that magnetic lock **178** and armature **179** are relocated to second door **42**, one skilled in the art would understand that lip **43** would need to extend from first door **40**.

[0058] Now referring more specifically to FIG. **1**C, a top perspective view of housing unit **20** is shown with first ventilated port **50**, second ventilated port **52**, third ventilated port **54**, exterior sensor port **56**, and engine encasement **70**, wherein engine encasement **70** comprises ozone generation system **60**, ozone destruction system **120**, and main fan **62**. Ventilated port **50** is formed within engine encasement **70** to allow ambient air to enter chamber **25** and circulate over UV lamps **64** via the operation of main fan **62**. Ventilated port **52** and third ventilated port **54** are to allow ambient air inside chamber **25** and air inside chamber **25** to be exhausted via first inlet fan **49** and second exhaust fan **51**, respectively, after a heat cycle or dry cycle, as more fully described below. Coupled with each ventilated port **52**, **54** is first vent valve **53** and second vent valve **55**, respectively, wherein vent valves **53**, **55** are in electrical communication with PLC **170** of control system **160**. Vent valves **53**, **55** are closed except during a drying phase as fully described below.

[0059] Now, with reference to FIGS. **2**A-**2**C, inclusive, ozone generation system **60** comprises main fan **62**, UV lamps **64**, ballasts **65** and frame **71**, wherein frame **71** contains preferably four (4) UV lamps **64** and four (4) ballasts **65**, and wherein UV lamps **64** operate between a wave length of 160-240 nm, and preferably at a wave length of 185 nm; thus, allowing the lamps to produce ozone from ambient air. UV lamps **64** require a specific range of voltage and current to operate correctly, therefore each ballast **65** is electrically connected to each UV lamp **64** to regulate the flow of electricity to each UV lamp **64** to ensure that each receives the correct amount of power. In the preferred embodiment, each UV lamp **64** has a power rating of 48 watts. UV lamps **64** are attached to and carried by frame **71**, wherein UV lamps **64** are electrically connected to control system **160**. Frame **71** is positioned in close proximity to main fan **62**, wherein first vents **66** and second vents **68** in frame **71** allow air flow to traverse over UV lamps **64** to facilitate the generation of ozone. Although the preferred embodiment utilizes four (4) UV lamps **64** having a power rating of 48 watts, it is contemplated in alternate embodiment that six (6) or more UV lamps and/or UV lamps **64** with differing power ratings may be utilized based on known parameters, such as the volume of chamber **25** and the desired ozone level for treatment. Likewise, with smaller embodiments having a chamber **25** of smaller volume, it is contemplated that fewer UV lamps **64** may be utilized, as long as the desired level of ozone treatment (20 ppm/20,000 ppb) is achieved and sustained within a reasonable treatment period (preferably approximately 20 minutes) to achieve 99.9% reduction in viral titers and a 99.9% reduction in bacteria count. Additionally, although the preferred method to create ozone is via said UV lamps **64**, it is contemplated that other known methods such corona discharge could be utilized in alternate embodiments.

[0060] Now, with reference to FIGS. **3**A-FIG. **3**F, inclusive, humidity generation system **80**, preferably comprises water tray **82**, Piezo mister **88**, plunger mechanism **90**, and perforated basket **100** attached to and carried by base plate **118**, wherein base plate **118** comprises a ledge **119**, and wherein base plate **118** is attached to engine encasement **70**. In alternate embodiments, it is contemplated that base plate **118** could be attached to any member of housing **20**, as long as airflow from main fan **62** is directed over humidity generation system **80**. Water tray **82** is a one-sided open generally cuboid shape having an inside volume **86** for receiving distilled water. It is contemplated that water tray **82** could have any shape as long as an inside volume **86** is defined therein to hold distilled water for the generation of humidity.

[0061] Additionally, although distilled water is the preferred liquid for humidification, it is contemplated that other liquids such as spring water, filtered water, or tap water with or without additives may be utilized; however, some waters, especially tap water, typically contain minerals that will leave deposits and scale thus requiring more frequent sanitizing and disinfecting, and the risk of added microorganisms; and, therefore, is not preferred.

[0062] Water tray **82** further comprises lip **84** around and extending outwardly from the open perimeter thereof for securing water tray **82** in position. More specifically, in the secured/use position, lip **84** of water tray **82** rests partially upon ledge **119** of base plate **118**. To facilitate the easy removal of water tray **82** for refilling and/or cleaning, a plunge mechanism **90** is utilized under one edge of lip **84**, wherein plunge mechanism comprises spring-loaded plunger **92** and bracket **94** having a through-hole **97** therethrough. Spring-loaded plunger **92** comprises a head portion **93**, distal end **96**, and intermediate area **98**, wherein spring-loaded plunger extends through through-hole **97** of bracket **94**, and wherein distal end **96** rests under a portion of lip **84** of water tray **82**. In the resting position, spring-loaded plunger **92** secures water tray **82** in position.

[0063] When water needs to be added to water tray **82**, the user pulls the head portion **93** of spring-loaded plunger **92**, thereby releasing distal end **92** from lip **84**, allowing water tray **82** to be easily removed. Further, attached to and carried by base plate **118** is corrugated cage **100**, wherein corrugated cage **100** is defined by swinging door **102**, 3-sided wall member **108**, top member **106**, bottom member **110**, shoulders **112**, and through-holes **114**, wherein an inside area **116** is formed therebetween. Shoulders **112** having through-holes **114** allow corrugated cage **100** to be attached to base plate **118** of housing **10**.

[0064] In use, known Piezo mister **88** is placed within inside area **116** on bottom member **110**. In order to allow a user to inspect and/or replace Piezo mister **88**, swinging door **102** is attached to 3-sided wall member **108** at hinged joints **104**. Corrugated cage **100** is dimensioned to fit within and generally at the center of inside area **86** of water tray **82**. Once Piezo mister **88** is placed on bottom member **110** of corrugated cage **100**, swinging door **102** is closed and water tray **82**, having water therein, is placed in position, by first pulling spring-loaded plunger **92** and placing lip **84** on ledge **119**, wherein corrugated cage **100** rests inside of water tray **82**, and wherein Piezo mister **88** is submerged in the water.

[0065] Piezo misters **88** have a known optimum operating water level or depth requirement of approximately 1 inch above the piezo disk, wherein the level of water inside water tray **82** is, preferably at or near this optimum operating water level or depth. To facilitate the filling of water to this optimum operating depth, a “fill line” (not shown) is provide on water tray **82** for the user.

[0066] Piezo mister **88** is electrically connected to control system **160** via wire **87**. After its determined that the level of humidity inside chamber **25** is below the minimum start point humidity level (as described below), PLC **170** of control system **160** will send electrical current to the atomizer of Piezo mister **88**, wherein rapid ultrasonic frequencies are generated thus causing the water to be pushed through the mesh disc producing tiny droplets or mist. The Piezo mister **88** is placed in close proximity to main fan **62** and/or an air duct **99** (as shown in FIG. **3**F) is added such that a portion of air from main fan **62** is directed to humidity generation system **80** to facilitate the humidification process in chamber **25**. In the preferred embodiment, air duct **99** is utilized for this process; however, in alternate embodiments, it is contemplated that air duct **99** is not utilized. It should be noted that in alternate embodiments, it is contemplated that more than one Piezo mister **88** may be utilized, wherein the speed at which humidification takes place is increased.

[0067] Now, with reference to FIGS. **4**A-**4**E, inclusive, an alternate embodiment of a humidity generation system **180** is shown, wherein humidity generation system **180** comprises water pan **182**, shelf **188**, and wicking filters **186**. Water pan **182** is generally a rectangular-shaped pan having a fill area **183** and a divider **184**, wherein divider **184** is generally positioned longitudinally within fill area **183** of water pan **182**. Water pan **182** is dimensioned to partially receive two (2) each of wicking filters **186** on each side of divider **184**, such that, in this alternate embodiment, water pan **182** could hold a total of four (4) wicking filters **186**.

[0068] In a single door alternate embodiment **200** as shown in FIGS. **10**A-**10**B, inclusive, only one (1) wicking filter **186** is needed, whereas in the 2-door preferred embodiment **10**, two (2) wicking filters **186** is utilized. However, it is contemplated in alternate embodiments that more wicking filters **186** may be utilized to increase the speed at which humidification takes place.

[0069] Only the lower portion of wicking filters **186** are submerged in water such that as air passes over wicking filters **186**, water travels up and then evaporates to increase the moisture, and thus, humidity within chamber **25**. Water pan **182** is held in position proximal to main fan **82** via shelf **188**, wherein shelf **188** is generally L-shaped having a ledge **192** and a horizontal member **190**, and wherein ledge **192** is used to attach shelf **188** to base plate **118**, and wherein horizontal member **190** is dimensioned to rest thereon water pan **182**.

[0070] In use, water pan **182** is filled with clean water, preferably is distilled, and wicking filters **186** are placed therein. Then, water pan **182** is placed on horizontal member **190** of shelf **188**. Similarly to the preferred embodiment, it is contemplated that air duct **99** could be utilized in alternate embodiments to facilitate air flow from the main fan to humidity generation system **180**.

[0071] In use, before the present invention can be safely opened after a treatment, ozone levels within chamber **25**, as measured by internal sensor **172**, must be below OSHA safe level requirements of 0.10 ppm. In the present invention, acceptable ozone levels are set to a level of less than 200 ppb before control **160** will allow the user to open doors **40**, **42**. Although ozone, over time, will naturally decay to oxygen (half-life at typical room temperature of about 7-10 minutes), this period of time to allow the ozone to go from the preferred treatment level of 20 ppm/20,000 ppb to safe levels below 0.10 ppm could take well over an hour.

[0072] As such, to expedite the destruction of ozone and thus speed up the entire cycle time, an ozone destruction system **120** is utilized. With reference to FIGS. **5**A-**5**E, inclusive, ozone destruction system **120** is attached within engine encasement **70** and comprises case **122**, destructor fan **124**, and catalyst **126**, wherein destructor fan **124** and catalyst **126** are attached to and carried by case **122**. Case **122** has an open inlet **125** and an open outlet **127**, wherein destructor fan **124** is positioned proximal to inlet **125** and wherein catalyst **126** is positioned downstream between destructor fan **124** and outlet **127**, such that when destructor fan **124** is activated by control system **160** after an ozone treatment, ozonated air within chamber **25** is allowed to flow into inlet **125**, over catalyst **126** and out of outlet **127**. Catalyst **126** serves to expedite the chemical reaction of ozone (O.sub.3) to oxygen (O.sub.2). In the preferred embodiment, catalyst **126** is manganese dioxide (MnO.sub.2); however, other known catalyst such as oxides of Co, Cu, Fe, Ni, Si, Ti, Zr, Ag, and Al, or combination thereof, may be utilized. Catalyst **126**, in the preferred embodiment, comprises two layers spaced apart approximately one fourth of an inch (¼″). This ¼″ air gap further facilitates the conversion of ozone to oxygen. This is because the introduction of an air gap reduces flow speed of the fluid through the 2nd catalyst layer, and increases total exposure of the fluid to the catalyst material, increasing destructor efficiency. Internal sensor **172** operates continuously, at a preferred rate of once per second, and measures the ozone level within chamber **25**. Until internal sensor **172** indicates to controller **160** that said ozone levels are below 200 ppb, destructor fan **124** will continue to operate.

[0073] With continuing reference to FIG. **1**A-**1**D, inclusive, and with further reference to FIGS. **6**-**9**, inclusive, control system **160** comprises programmable logic controller (PLC) **170**, expansion module **171**, wiring **169**, wire bus **168**, external sensor **174**, internal sensor **172**, power regulator **167**, main power switch **164**, control panel **162**, exterior emergency stop button **163**, interior emergency stop button **165**, sweep button **166**, magnetic lock **178**, armature **179**, and a power source, wherein all of said components of control system **160** are in electronic communication. In the preferred embodiment, the above components of control system **160** are hardwired together via wiring **169**; however, it is contemplated in alternate embodiments that some or all of said components could be electronically connected via any known wireless means. PLC **170** serves as the programmable brains of control system **160**, wherein input data from the various components will, based on programmed perimeters (as discussed elsewhere herein), determine the output controls of PLC **170**. More specifically, with a power source supplied and main power switch **164** opened, power regulator **167** provides the necessary power to control system **160**, ozone generation system **60**, humidity generation system **80**, ozone destruction system **120**, and heating system **250** (if applicable). Via wiring **169**, expansion module **171**, and wire bus **168**, the components of the various systems are able to provide input to and receive output from PLC **170**.

[0074] Now referring to FIGS. **10**A-**10**B, inclusive, alternate embodiment **200** is shown, wherein alternate embodiment **200** is a single-door unit, and wherein, similar to preferred embodiment **10**, alternate embodiment **200** comprises all the same systems and operates in the same manner as preferred embodiment **10**. The primary differences between alternate embodiment **200** and preferred embodiment **10**, are that housing **220** of alternate embodiment **200** is smaller in size, only has one door and, if alternate humidity generation system **180** is utilized, only one (1) wicking filter **186** is used as previously discussed. Notwithstanding, wick count ultimately is determined based upon ambient humidity conditions of the unit's location. Additionally, if alternate embodiment **200** is being operated with a heat unit, then the heat unit typically will be placed on the bottom tray of the cart. Consequently, only housing **220** will be detailed. Housing **220** is generally rectangular shaped and comprises a floor member **222**, a rear wall **224**, a first side wall **226**, a second side wall **228**, an upper member **230**, and a door **240**, wherein said members are connected to define a closeable chamber **25** therebetween. Similar to preferred embodiment **10**, door **240** comprises a viewing window **244** to allow a user to see within chamber **25** during use.

[0075] A multitude of safety features are incorporated into the present device **10** and its alternate embodiments to ensure a safe operation for both the user and the surrounding environment. Generally, and as will be further detailed below in the discussion of the process steps, sweep button **166** is positioned on the inside of housing unit **20**, wherein a user, prior to beginning a treatment cycle, inspects chamber **25** to ensure no humans or other animals are therein and then must push sweep button **166** before the control system **160** will allow the user to continue. As an additional safety feature, a user must also enter a code on control panel **162** before continuing. It is noted that, once the user pushes the sweep button, the treatment cycle must be started within thirty (30) seconds, or the cycle will time-out and be discontinued.

[0076] Once the above two preliminary steps are completed, the user can then activate a treatment cycle via control panel **162**. Immediately, control system **160** energizes magnetic lock **178** to ensure that first door **40** and second door **42** are secured closed before and during said treatment cycle. If for any reason doors **40**, **42** are opened, control system **160** shuts down said treatment cycle. Additionally, in the unlikely event that the user neglected to see a person inside of chamber **25**, interior emergency stop button **165** is provided, wherein when pushed, control system **160** immediately shuts down said treatment cycle and unlocks doors **40**, **42**. An external emergency stop button **163** is also provided that functions similar to shut down and unlock in the event the user pushed same during an emergency situation.

[0077] In addition to these safety features, sensors are incorporated to provide various data (ozone levels, humidity, and temperature) to PLC **170**, wherein under certain conditions that may indicate an issue or potentially unsafe parameter, PLC **170** can take corrective measures to remediate or mitigate the potentially unsafe condition. More specifically, if internal sensor **172** detects that the ozone levels inside chamber **25** are higher than the acceptable levels during a treatment cycle, this information is communicated to PLC **170** and then PLC **170** shuts down ozone generating system **60**. In the highly unlikely event that ozone generating system **60** fails to shut down, PLC **170** can completely shut down the entire system. If external sensor **174** detects ozone on the exterior of housing **20**, potentially indicating that there is a leak, this information is communicated to PLC **170**, wherein PLC **170** can immediately activate ozone destruction system **120** and/or shut down the treatment cycle. Additionally, prior to allowing the user to be able to open doors **40**, **42**, PLC **170** must receive data from internal sensor **172** that the ozone levels inside chamber **25** have reached safe levels.

[0078] In addition to the above safety features, control system **160** controls the entire treatment cycle to ensure that the present invention performs as expected, whether that is a 99.9% reduction in viral titers, a 99.9% reduction in bacteria count, the eradication of lice, bedbugs, and their eggs, and/or a sufficient drying of damp/wet target objects.

[0079] The following is a breakdown of the preferred treatment cycle for the various applications. As referenced below, although the preferred exterior humidity setpoint, the interior minimum starting humidity setpoint, the ozone setpoint, the ozone overshoot period, the ozone treatment period, the heat setpoint, the heat treatment period, the drying treatment period, and the various steps are designated below for the preferred embodiment, it is contemplated that these values and steps can vary depending on various known factors such as, for exemplary purposes only, the virus or bacteria to be targeted and the objects being treated, wherein based on the present disclosure coupled with known scientific research, one skilled in the art would know how to vary these parameters and steps to accomplish the intended goal. It should also be noted that based on the disclosure herein, one skilled in the art would be able to program PLC **170** to accomplish the following parameters, other parameters and/or other steps as contemplated by the various alternate embodiments and other treatment cycles hereof and as desired by the user; and thus, the present invention should not be limited in any way to the following steps, order of steps, and/or parameters:

Sanitizing Cycle

[0080] (a.) User loads chamber **25** with items to be treated; [0081] (b.) User verifies that no person or other animal is inside chamber **25** and presses sweep button **166**; [0082] (c.) User closes doors **40**, **42** and enters an access code on control panel **162**; [0083] (d.) User selects “Start Sanitizing Cycle” on control panel **162**; [0084] (e.) Control system **160** verifies that doors **40**, **42** are closed and locked via magnetic lock **178**; [0085] (f.) Control system **160** checks outside humidity level via external sensor **174**; [0086] (g.) If outside humidity level is above setpoint (55% in a preferred embodiment), cycle begins; [0087] (h.) If outside humidity level is below setpoint, the cycle pauses for two minutes to accurately measure the humidity level inside the machine via internal sensor **172**; [0088] (i.) If the inside humidity level is below the minimum starting setpoint (55% in a preferred embodiment), the cycle countdown timer pauses until humidity generation system **80** raises the level above the minimum starting setpoint. During this pause, control panel **162** displays “Preparing to Sanitize;” [0089] (j.) Once the inside humidity level is above the minimum starting setpoint, ozone lamps **64** of ozone generation system **60** turn on and a cycle countdown timer begins (preferably 20 minutes); [0090] (k.) Ozone lamps **64** remain on until internal sensor **172** detects an ozone reading exceeding the ozone setpoint (20 ppm/20,000 ppb in a preferred embodiment) for a predetermined “overshoot” period (90 seconds in a preferred embodiment); [0091] (l.) If the ozone level in chamber **25** drops below the setpoint, ozone lamps **64** turn on until ozone reading via internal sensor **172** exceeds the setpoint for the predetermined “overshoot” period; [0092] (m.) The previous step repeats until the timer reaches the end of the ozone treatment period (20 minutes in a preferred embodiment); [0093] (n.) After the ozone treatment period, control system **160** initiates the ozone destruction period by turning on destructor fan **124** of ozone destruction system **120** to blow air across the manganese dioxide catalyst **126** to convert ozone to oxygen; [0094] (o.) Air is circulated through catalyst **126** of ozone destruction system **120** until the ozone level drops to the level that is safe to open the door (under 20 ppm/20,000 ppb) typically 18 minutes in the preferred embodiment; [0095] (p.) If necessary, the 18-minute destruct period will automatically be extended to ensure that the ozone level drops to the level that is safe to open the door; [0096] (q.) Control panel **162** then displays that the cycle is complete; [0097] (r.) If control system **160** detects that key cycle parameters were not met, control panel **162** notifies that user of the deficiency; and [0098] (s.) The user can then enter an access code on control panel **162** to unlock doors **40**, **42** and remove the treated items from chamber **25**.

Heat Cycle

[0099] (a.) User loads chamber **25** with items in to be treated; [0100] (b.) User verifies that no person or other animal is inside chamber **25** and presses sweep button **166**; [0101] (c.) User closes doors **40**, **42** and enters an access code on control panel **162**; [0102] (d.) User selects "Start Heat Cycle" on control panel **162**; [0103] (e.) Control system **160** verifies that doors **40**, **42** are closed and locked via magnetic lock **178**; [0104] (f.) Heating system **250** turns on and the cycle countdown timer begins (in a preferred embodiment 90 minutes); [0105] (g.) Heating system **250** remains on until the air temperature in the cabinet, as measured by internal sensor **172**, achieves the setpoint (in the preferred embodiment 125° F.) for at least 15 seconds. Heating system **250** then remains off for 3 minutes; [0106] (h.) When heat system **250** turns on again, it stays on until the air temperature in the cabinet achieves the setpoint (typically 125° F.) for at least 15 seconds; [0107] (i.) The previous step repeats until the timer reaches the end of the heat treatment period, typically 90 minutes; [0108] (j.) The control panel **162** then displays that the cycle is complete; [0109] (k.) If the control system **160** detects that key cycle parameters were not met, control panel **162** notifies the user of the deficiency; and [0110] (l.) The user can then enter an access code on control panel **162** to unlock doors **40**, **42** and remove the treated items from chamber **25**.

Dry Cycle

[0111] (a.) User loads chamber **25** with items in to be treated; [0112] (b.) User verifies that no person or other animal is inside chamber **25** and presses sweep button **166**; [0113] (c.) User closes doors **40**, **42** and enters an access code on control panel **162**; [0114] (d.) User selects "Start Dry Cycle" on control panel **162**; [0115] (e.) Control system **160** verifies that doors **40**, **42** are closed and locked via magnetic lock **178**; [0116] (f.) Control system **160** then opens inlet vent valve and outlet vent valve, activates exhaust fan, and activate heat system **250**. The cycle countdown timer begins; [0117] (g.) Heat system **250** remains on unless the air temperature in the cabinet exceeds the control setpoint (in the preferred embodiment 125° F.) for at least 15 seconds. Heat system **250** remains off for 3 minutes; [0118] (h.) When heat system **250** turns on again, it stays on until the air temperature in the cabinet exceeds the setpoint (typically 125° F.) for at least 15 seconds; [0119] (i.) The previous step repeats until the timer reaches the end of the selected drying period and then vent valves **53**, **55** are closed; [0120] (j.) Control panel **162** then shows that the cycle is complete; and the user can then enter an access code on control panel **162** to unlock doors **40**, **42** and remove the treated items from chamber **25**.

[0121] For convenience of the reader, following is a summary of parts and reference numbers in the written Specification and Drawings hereof:

TABLE-US-00001 Part Number Part Description 10 Preferred Embodiment 20 Housing Unit 22 Floor Member 24 Rear Wall 25 Chamber 26 First Side Wall 28 Second Side Wall 30 Upper Member 40 First Door 42 Second Door 43 Lip 44 Viewing Window 45 Handle 48 Hinges 49 First Inlet Fan 50 First Ventilated Port 51 Second Exhaust Fan 52 Second Ventilated Port 53 First Vent Valve 54 Third Ventilated Port 55 Second Vent Valve 56 Exterior Sensor Port 60 Ozone Generation System 62 Main Fan 64 UV Lamps 65 Ballasts 66 First Vents 68 Second Vents 70 Engine Encasement 71 Frame 80 Humidity Generation System 82 Water Tray 84 Lip 86 Inside Area 87 Wire 88 Piezo Mister 90 Plunger Mechanism 92 Spring-loaded Plunger 93 Head Portion 94 Bracket 96 Distal End 97 Through-holes 98 Intermediate Area 99 Air Duct 100 Corrugated Cage 102 Swinging Door 104 Hinged Joints 106 Top Member 108 3-Sided Wall Member 110 Bottom Member 112 Shoulders 114 Through-holes 116 Inside Area 118 Base Plate 119 Ledge 120 Ozone Destruction System 122 Case 124 Destructor Fan 125 Inlet 126 Catalyst 127 Outlet 160 Control System 162 Control Panel 163 Exterior Emergency Stop Button 164 Main Power Switch 165 Interior Emergency Stop Button 166 Sweep Button 167 Power Regulator 168 Wire Bus 169 Wiring 170 PLC 171 Expansion Module 172 Internal Sensor 174 External Sensor 178 Magnetic Lock 179 Armature 180 Alternate Humidity Generation System 182 Water Pan 183 Fill Area 184 Divider 186 Wicking Filters 188 Shelf 190 Horizontal Member 192 Ledge 200 Alternate Embodiment 220 Single Door Housing Unit 222 Floor Member 224 Rear Wall 226 First Side Wall 228 Second Side Wall 230 Upper Member 240 Door 244 Viewing Window 250 Heating System 252 Heating Element 254 Blower

[0122] Having, thus, described exemplary embodiments of the subject matter of the present disclosure, it is noted that the within disclosures are exemplary only, and that various other alternatives, adaptations, and modifications may be made within the scope and spirit of the present inventive subject matter. Accordingly, the present subject matter is not limited to the specific embodiments as illustrated herein, but is limited only by the following claims.

Claims

1. An ozone sanitizing and disinfecting device comprising a closable chamber, an ozone generating device, a humidity generating system, a catalyst to convert ozone to oxygen, and a control system capable of maintaining a minimum level of relative humidity in the chamber between treatment cycles.
2. The device of claim 1 further comprising a sensor to measure the relative humidity in the surrounding environment and can predictively modify the treatment cycle parameters to ensure that the proper relative humidity is achieved inside the device during the treatment cycle resulting in a shorter treatment cycle.
3. The device of claim 1 further comprising a humidity generating system that is accessible, without the use of tools, by the user for periodic water replenishment and cleaning.
4. The device of claim 1 further comprising a humidity generating system with a water level indication that is easily viewable when the operator opens the chamber door(s).
5. The device of claim 1 further comprising a humidity generating system that uses a fan and wicking filters to evaporate water.
6. The device of claim 1 further comprising a humidity generating system that uses a piezoelectric transducer to atomize water.
7. The device of claim 1 further comprising a system to introduce ambient air from the surrounding environment into the chamber, after the treatment cycle, to ensure that the inside of the chamber is below the humidity level that allows mold to grow.
8. An ozone sanitizing and disinfecting device comprising a closable chamber, an ozone generating device, a humidity generating system, a catalyst to convert ozone to oxygen, and a control system capable of maintaining a minimum level of relative humidity in the chamber between treatment cycles, said ozone sanitizing and disinfecting device further comprising a sensor to measure the relative humidity in the surrounding environment and can predictively modify the treatment cycle parameters to ensure that the proper relative humidity is achieved inside the device during the treatment cycle resulting in a shorter treatment cycle.
9. The device of claim 8 further comprising a sensor to measure the relative humidity in the surrounding environment and can predictively modify the treatment cycle parameters to ensure that the proper relative humidity is achieved inside the device during the treatment cycle resulting in a shorter treatment cycle.
10. The device of claim 8 further comprising a humidity generating system that is accessible, without the use of tools, by the user for periodic water replenishment and cleaning.
11. The device of claim 8 further comprising a humidity generating system with a water level indication that is easily viewable when the operator opens the chamber door(s).
12. The device of claim 8 further comprising a humidity generating system that uses a fan and wicking filters to evaporate water.
13. The device of claim 8 further comprising a humidity generating system that uses a piezoelectric transducer to atomize water.
14. The device of claim 8 further comprising a system to introduce ambient air from the surrounding environment into the chamber, after the treatment cycle, to ensure that the inside of the chamber is below the humidity level that allows mold to grow.
15. A method of disinfecting and sanitizing objects, said method using a closable and lockable

chamber having an ozone generation system, an ozone destruction system, and a humidity generation system, all in electronic communication with a control system, comprising the steps of: a. placing at least one object to be disinfected and sanitized inside said closable chamber; b. closing and locking said closable chamber; c. activating, if needed, said humidity generation system via said control system to achieve a predetermined humidity level within said closable chamber; d. activating said ozone generation system via said control system to achieve a predetermined ozone level within said closable chamber from ambient air for a predetermined period, wherein said ozonated air traverses the object(s) to be disinfected and sanitized; e. activating said ozone destruction system via said control system to achieve a predetermined reduction in ozone level within said closable chamber; f. unlocking said chamber via said control system.

16. The method of claim 15, wherein said closable and lockable chamber further has a heating system in electronic communication with said control system, further comprising the steps of: activating said heating system via said control system to achieve a predetermined temperature within said chamber for a predetermined period.