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DESCRIPTION

CLAIM OF PRIORITY

[0001] This patent application claims the benefit of priority of U.S. Provisional Patent Application Serial No. 62/286,487, entitled "Biosecurity System for Agricultural Dwelling," filed on January 25, 2016, (Attorney Docket No. 12-136P).

TECHNICAL FIELD

[0002] This patent application is directed generally, but not by way of limitation, to biosecurity. More specifically, toward a method of sanitizing an agricultural facility.

BACKGROUND

[0003] Over the last several decades the agricultural industry has gone from traditional family farms that typically are outdoors to large corporate farms and processing plants that are mainly indoors. While such a move was done to increase efficiencies and reduce costs, new found problems have occurred. In particular, over the last several years virus and bacteria have infiltrated agricultural facilities. In the swine industry the Porcine Epidemic Diarrhea (PED) virus has wiped out entire swine farms in North America. Meanwhile poultry have been hit with the avian flu on multiple occasions over the last several years.

[0004] When these diseases infiltrate a farm, whether swine or poultry, typically all of the animals must be culled and the building completely scrubbed down and sanitized to get rid of the disease. This process causes a complete loss of the flock or litters, costing farms millions of dollars in damages from lost livestock. In addition, the entire industry is effected when growers are unable to keep up with supply demands during such a time, thereby raising costs and harming the industry.

[0005] As a result, agricultural building typically have protocols in place regarding visitors and those working in such a facility. For instance, often those that have visited another corporate farm in a previous month are not allowed onto a different farm. Also coverings at facilities are provided for individual's feet to stop potential bacteria or virus on shoes from being tracked into a facility.

[0006] Other methods have been developed to reduce virus and bacteria within agricultural facilities. For example, bio-secure chambers exist in the art that utilize UV light within the chamber so that clothing and items such as keys, wallets, food containers and the like can be placed in the chamber for a predetermined period of time to inactivate or kill all bacteria and

viruses on the surfaces they receive the UV light. Alternatively, by eliminating red light within a lighting fixture that promotes bacteria growth, and using blue light that inhibits bacteria growth, lighting devices can be provided that increase biosecurity and reduce bacteria.

[0007] Document US2005/0186108A1 discloses a bio-air sterilization system that circulates air in an enclosed area, wherein contaminants and particulates are removed from the air drawn in. This is partly done by a first ultraviolet lamp generating ions that attach to the contaminants and particulates, and by a second ultraviolet lamp converting oxygen into ozone.

[0008] Still, problems remain. In particular, while utilizing blue light can have positive effects on poultry or livestock, humans typically prefer the use of white light in working environments. Therefore blue lighting is not utilized within agricultural facilities and viruses and bacteria remain problematic. Thus, a need in the art exists for an improved biosecurity system for an agricultural dwelling.

SUMMARY

[0009] A method of sanitizing an agricultural facility, including monitoring at least one room of an agricultural facility with a sensor to detect a human. A first light having a first spectral content is provided when a human is detected. Then when a human is no longer detected a second light having a second spectral content within a narrow range of wavelengths to inhibit bacteria growth is provided.

[0010] This overview is intended to provide an overview of subject matter of the present patent application. It is not intended to provide an exclusive or exhaustive explanation of the invention. The detailed description is included to provide further information about the present patent application.

[0011] The present invention is defined by the independent claim and corresponding dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] In the drawings, which are not necessarily drawn to scale, like numerals may describe similar components in different views. Like numerals having different letter suffixes may represent different instances of similar components. The drawings illustrate generally, by way of example, but not by way of limitation, various embodiments discussed in the present document.

Fig. 1 is a perspective view of a sanitation chamber in an open position;

Fig. 2 is a perspective view of a sanitation chamber in a closed position;

Fig. 3 is a cut away perspective view of a sanitation chamber;

Fig. 4 is a schematic diagram of a timing circuit of a sanitation chamber;

Fig. 5 is a schematic diagram of an agricultural facility;

Fig. 6 is a schematic diagram of a lighting system;

Fig. 7 is a decision flow chart of a method of sanitizing an agricultural facility;

Fig. 8 is a schematic diagram of a sanitation chamber;

Fig. 9 is a perspective view of a sanitation chamber; and

Fig. 10 is a front plan view with hidden lines of a sanitation chamber.

DETAILED DESCRIPTION

[0013] In aspects not being part of the present invention:

Figures 1-3 depict a chamber 10 having a body 12 that in an embodiment is generally shaped like a box, or has a rectangular cross section. In particular, in this aspect the body 12 has a frame 14 with first support members 16 running in parallel spaced relation in an X-axis, second support members 18 running in parallel spaced relation in a Y-axis and perpendicular to the first support members and third support members 20 running in parallel spaced relation in a Z-axis perpendicular to both first and second support members 16 and 18, thus forming the frame 14 having a square or rectangular cross section.

[0014] The first, second and third support members 16, 18 and 20 support first and second sidewalls 22 and 24 that are in parallel spaced relation that extend between a top wall 26 and bottom wall 28. First and second door members 30 and 32 are hingedly connected to the first and second sidewalls 22 and 24. The door members 30 and 32 while described as hingedly connected can be connected to the first and second sidewalls 22 and 24 in other manners that allow the door members 30 and 32 to be opened to gain access to the open interior of the chamber. This includes being connected to the top or bottom walls 26 and 28.

[0015] The interior of the chamber includes a retractable tray member 36 on which one or more items 38 such as clothing, pieces of jewelry, feed, packages, water containers, tools, beverage containers and the like can be placed. In an example, the tray member 36 is within tracks and slides outwardly until engaging a stop member. In other examples the tray member 36 is on rollers and again engages a stop member when extended. By having two separate door members 30 and 32 in association with the tray member 36 an individual can place the items 38 into the first door member 30, then go through decontamination themselves, and then get their items 38 through the opposite door member 32. This provides a user with additional

flexibility and functionality regarding where to locate the UV reflective material. The reflective plate 54 surrounds attachment members 56 such as c-shaped clamps. In this example the lighting device has a transparent tubular body 58 that preferably is made of a material that absorbs a minimal amount of UV wavelength light, or a wavelength between 100 nanometers (nm) and 400 nm, more preferably 200 nm - 300 nm, even more preferably between 250 nm - 260 nm, and more preferably approximately 254 nm, to the interior of the chamber 10.

[0016] In this example a first light holder 52 is secured to the body 12 of the chamber 10 running along the corner of the chamber 10 created between the first sidewall 22 and the top wall 26 and extending the length of the interior 34. When in place the PCB is angled at the center of tray member 36 and the reflective plate 54 arcuately extends around the tube in approximately a half circle such that a maximum amount of light is directed directly at the tray member 36. Similarly a second light holder 52 extends in the opposite corner of the chamber 10 adjacent the second sidewall 24 and top wall 26 again having the same light holder 52 and with the UV radiation toward the tray member 36. While these lighting devices have been described as on a light holder 52, the lighting devices could be secured directly to the chamber 10 or other similar mounting means without falling outside the scope of this disclosure. Also, while the lighting device 50 has been described as UV wavelength as described above angled toward the tray member 36. The lighting device 50 in one example has an electrical connector 63 that can only be inserted or actuated with a predetermined connector. In this manner, if an individual were to remove the chamber, they would be unable to power the lighting device 50 from a common power source or common means to ensure UV reflective material that absorbs a minimal amount of UV reflective materials the chamber maximizes the effect of UV radiation is maximized.

[0017] A control panel 80 is disposed below each door member 30 and 32 and includes an emergency stop button 82, a timer button 84 and an indicator light 86. Disposed within and originating from a compartment within the chamber 10 is electrical wiring 88 for the electronic components 50, 72, 82, 84 and 86 of the UV lighting devices 50 that only plug into the connector of the UV light that can be harmful to the eyes of humans cannot be emitted by the lighting devices 50 when a door member 30 or 32 is open.

[0018] In Figure 4, a timing circuit 102 is connected to the input line L and neutral line N and is electrically connected to the timer button 84, such that when both door members 30 and 32 are closed and interlocked and a timer button 84(PB1 and PB2) is actuated the timing circuit 102 is actuated. The timing circuit provides current to the ballasts (BL1 and BL2, and BAL1 and BAL2) of lighting devices 50 for a predetermined period of time. In one example the predetermined period is approximately two minutes. The predetermined amount of time can be several seconds to several days without falling outside the scope of this disclosure.

[0019] The timing circuit 102 is also connected in parallel with the ballast (BL1 and BL2, and BAL1 and BAL2) for the lighting devices 50 indicator lights 86 (LT1 and LT2) such that while the lighting devices 50 receive current the indicator lights 86 similarly receive current and lights to provide a warning to users that the chamber 10. This provides a warning to a user that the

door members 30 and 32 should remain closed.

[0020] In operation, the chamber 10 is placed at the entrance of a swine facility. When an individual comes to the swine facility, before entering the individual takes any packages, feed, water, jewelry, shoes, clothing tools, or the like and takes such items 38 and places them on the tray member 36. At this time the individual closes the chamber 10, ensuring the door members 30 and 32 are magnetically interlocked. Then the individual engages a timer button 84. If both door members 30 and 32 are not interlocked the electrical system 100 will not actuate as a result of the switches SW1 and SW2 and circuit relays C1 and the lighting devices 50 do not emit chamber and be harmful to a user.

[0021] If the door members 30 and 32 are completely closed and interlocking has occurred, the switches SW1 and SW2 and circuit relays CR1 provide a completed circuit allowing current to flow to the timing circuit 102. Thus, when the timer button 84 is actuated current flows to the ballasts (BL1 and BL2, and BAL1 and BAL2) of lighting devices 50 to direct UV radiation is present and the door members 30 should remain closed. In an example, the magnetic interlocking prevents opening of the door members 30 and 32 during the predetermined period of time. If a user ignores the indicator lights 86 and is able to open a door member 30 or 32, the circuit is no longer operable as a result of the switches SW1 or SW2 and the circuit relays CR1 thus stopping current flow to the ballasts (BL1 and BL2, and BAL1 and BAL2) of lighting devices 50 and the indicator lights 86 shut off. If a malfunction occurs and current continues to flow to the ballasts (BL1 and BL2, and BAL1 and BAL2) of lighting devices 50 and the indicator lights 86 remain on, a user recognizing this can actuate an emergency stop switch (ES1 or ES2) by actuating the emergency stop button 82.

[0022] Thus multiple methods are presented to minimize and eliminate an individual from being exposed to potentially harmful UV radiation radiates the item or items 38. Thus if a germ, microorganism, virus or the like is on the item 38 it is exposed to the UV radiation is absorbed by DNA of these microorganisms breaking the molecular bonds within the micro-organismal DNA, producing thymine dimers in the DNA preventing the DNA from replicating. In this manner, cells and viruses become inactive and unable to reproduce. Thus, if a virus such as the porcine epidemic diarrhea virus is on an item 38 the exposure to the UV agricultural facility, including for chickens, turkeys, cows, horses and the like and to inactivate or kill any germ, microorganism, virus or the like, both without falling outside the scope of this disclosure. In particular, the agricultural facility.

[0023] Figures 5-7 show another embodiment to accomplish sanitizing an agricultural facility. The agricultural facility 110 has multiple rooms 112 for housing both livestock 114 and humans 116. Within at least one room 112 is a biosecurity system 118. The biosecurity system includes a lighting system 120 and a biosecurity chamber 10.

[0024] The lighting system 120 comprises a first lighting element 122 that emits light at a predetermined color and a second lighting element 124 that emits light at a second predetermined color. In one example the first lighting element 122 emits white light and the

second lighting element 124 emits light at a wavelength that promotes biosecurity. In one example the second lighting element 124 emits light having a narrow band of wavelength in the blue wavelength range. In one example the first and second lighting elements 122 and 124 are within a single lighting device whereas in another example the first and second lighting elements 122 and 124 are in separate lighting devices. In one example the first and second lighting elements 122 and 124 each comprise a plurality of light emitting diodes.

[0025] A controller 126 is electrically and operably connected to the first and second lighting elements 122 and 124 to operate the lighting elements 122 and 124. In one example the controller is connected to first and second lighting elements by first and second switching elements 128 and 130 respectively, such that when the controller 126 actuates the first switching element 128 the first lighting element 122 emits light and when the second switching element 130 is actuated the second lighting element 124 emits light.

[0026] The controller 126 is also electrically connected to and receives information from sensor 132 and auxiliary sensor 134. The sensor 132 in one example is a motion detector that determines when an individual is within a predetermined space. The auxiliary sensor 134 determines an environmental condition associated with the room 112 in which the auxiliary sensor 134 is located. In an example, the environmental condition is the humidity within the room 112, and in another example the environmental condition is the temperature within the room 112. Similarly, the auxiliary sensor 134 could be designed to detect bacteria, a virus or predetermined chemical presence within the room 112 or a space where the second sensor is located.

[0027] The controller 126 is also electrically connected to and receives information from a timer 136. Specifically the controller has logic circuitry 138 therein that utilizes a decision matrix 140 based upon the inputs received from the first and second sensors 132, 134 and timer 136 to determine when to actuate first and second switching elements 128 and 130 to actuate first and second lighting elements 122 and 124.

[0028] Fig. 7 shows one example of the decision matrix 140. When the lighting system 120 is operating the first sensor 132 is operational to detect the presence of an individual at step 142. If an individual is detected, then the first switching element 128 is actuated and the first lighting element 122 is actuated such that white light is provided for the individual as indicated by step 144. If an individual is not detected, then the second lighting element 124 is actuated at a predetermined wavelength, such as blue light to inhibit bacteria growth as indicated by step 146. The first sensor 132 continues to monitor for the presence of an individual after either step 144 or 146 at steps 148 and 150. If not detected, then the second lighting element either switches to blue light at step 152 or continues to emit the blue light at step 154. If an individual is detected, then the first and second switching elements 128 and 130 are actuated accordingly and the second lighting element 124 is turned off or kept off while the first lighting element 122 remains on at step 156 or is turned on to provide white light at step 158. In an alternative example, the decision matrix may return to step 142 after entering step 144 or step 146 and a predetermined period of time has elapsed.

[0029] The decision matrix 140 can be accomplished in many different manners, including but not limited to utilizing a dimming system wherein a leading edge dimmer actuates the first switching element 128 and a falling edge dimmer controls the second switching element 130. In all, the decision matrix 140 can be adjusted to include a timing circuit and to have the first and second lighting elements 122 and 124 actuated simultaneously to provide simultaneous blue and white light in one example. In addition, the auxiliary sensor 134 can monitor humidity levels or other environmental conditions to detect an environment that is conducive for bacteria, viruses or other germs and adjusts the lighting system 120 to counteract the conditions by adding light, such as blue light into the environment. Thus the lighting system 120 can adjust to provide lighting for humans and still maximize biosecurity advantages.

[0030] To additionally sanitize the facility 110, in one example an ozone generator 160 is provided that generates or discharges ozone into a room 112. In one example, the ozone generator 160 is a corona discharge ozone generator. In another example, the ozone generator 160 is in communication with the sensors 132, 134 and/or timer 136 to only generate ozone when a human is not detected in the facility 110 or at a time humans are not allowed into the facility 110. In another example, the environmental condition detected by a sensor 132 or 134 is the level of ozone within the facility 110 or room 112 of the facility 110 and the ozone generator 160 is in communication with a security system of the facility 110 to keep doors of the facility 110 locked until a safe level of ozone for humans is within the facility.

[0031] Fig. 8 shows another example embodiment of the chamber 10. An ozone generator 310 in one example has an air intake 312 and water intake 314 to generate O₃ through ozone outlet port 316 and water outlet port 318. The water from the water outlet port 318 flows to a radiator 320 positioned adjacent a fan element 322 to move heated water vapor through an ozone discharge port 324 to discharge air and ozone into the chamber 10. The ozone generator 310 in one example generate ozone through a corona discharge. The ozone combines with either UV light or blue light to become even more effective at killing and inactivating bacteria and viruses.

[0032] An ozone filter system 326 is secured to the chamber to ensure when the chamber 10 is opened that harmful levels of ozone do not exist. The filter system 326 includes a carbon filter 328 that has an intake fan 330 and in one example utilizes active charcoal. In one example the filter 328 has a handle 329 and is removable and thus easily replaced with another filter. A conduit 332 conveys the filtered oxygen back into the interior of the chamber 10. The timing circuit of the chamber 10 is electrically connected to the ozone generator 310 to keep the door of the chamber locked for a predetermined period after shutting off the generator 310 to filter the air to have a safe level of ozone for humans before the chamber 10 can be opened.

[0033] One will appreciate that by using the chamber 10 with the ozone generator 310 and lighting system 120 that bacteria and viruses within an agricultural facility 110 are minimized to prevent the spread of disease. Consequently disease is prevented and facilities are saved from

massive losses. Thus, at the very least all of the problems of the background have been overcome.

[0034] In the present invention a method of sanitizing an agricultural facility is provided that includes monitoring at least one room of an agricultural facility with a sensor to detect a human. A first light is provided having a first spectral content when a human is detected. A second light is provided having a second spectral content within a narrow range of wavelengths to inhibit bacteria growth when a human is not detected.

[0035] In one example, the narrow range of wavelengths is in between 410nm-450nm. In another example, the narrow range of wavelengths is in the blue range of wavelengths. In yet another example, the sensor is a motion detector.

[0036] In one example an additional step of monitoring the room with an auxiliary sensor and providing the second spectral content based on an environmental condition of the room detected by the auxiliary sensor is provided. In another example, the first light is provided by a light emitting diode. In yet another example, an additional step of discharging ozone into the room for a predetermined period when a human is not detected is provided. In one example, the ozone is discharged by corona discharge.

[0037] The above description includes references to the accompanying drawings, which form a part of the detailed description. The drawings show, by way of illustration, specific embodiments in which the invention can be practiced. These embodiments are also referred to herein as "examples." Such examples can include elements in addition to those shown or described. However, the present inventors also contemplate examples in which only those elements shown or described are provided. Moreover, the present inventors also contemplate examples using any combination or permutation of those elements shown or described (or one or more aspects thereof), either with respect to a particular example (or one or more aspects thereof), or with respect to other examples (or one or more aspects thereof) shown or described herein.

[0038] In this document, the terms "a" or "an" are used, as is common in patent documents, to include one or more than one, independent of any other instances or usages of "at least one" or "one or more." In this document, the term "or" is used to refer to a nonexclusive or, such that "A or B" includes "A but not B," "B but not A," and "A and B," unless otherwise indicated. In this document, the terms "including" and "in which" are used as the plain-English equivalents of the respective terms "comprising" and "wherein." Also, in the following claims, the terms "including" and "comprising" are open-ended, that is, a system, device, article, composition, formulation, or process that includes elements in addition to those listed after such a term in a claim are still deemed to fall within the scope of that claim. Moreover, in the following claims, the terms "first," "second," and "third," etc. are used merely as labels, and are not intended to impose numerical requirements on their objects.

[0039] Geometric terms, such as "parallel", "perpendicular", "round", or "square", are not

intended to require absolute mathematical precision, unless the context indicates otherwise. Instead, such geometric terms allow for variations due to manufacturing or equivalent functions. For example, if an element is described as "round" or "generally round," a component that is not precisely circular (e.g., one that is slightly oblong or is a many-sided polygon) is still encompassed by this description.

[0040] Method examples described herein can be machine or computer-implemented at least in part. Some examples can include a computer-readable medium or machine-readable medium encoded with instructions operable to configure an electronic device to perform methods as described in the above examples. An implementation of such methods can include code, such as microcode, assembly language code, a higher-level language code, or the like. Such code can include computer readable instructions for performing various methods. The code may form portions of computer program products. Further, in an example, the code can be tangibly stored on one or more volatile, non-transitory, or nonvolatile tangible computer-readable media, such as during execution or at other times. Examples of these tangible computer-readable media can include, but are not limited to, hard disks, removable magnetic disks, removable optical disks (e.g., compact disks and digital video disks), magnetic cassettes, memory cards or sticks, random access memories (RAMs), read only memories (ROMs), and the like.

[0041] The above description is intended to be illustrative, and not restrictive. For example, the above-described examples (or one or more aspects thereof) may be used in combination with each other.

REFERENCES CITED IN THE DESCRIPTION

Cited references

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- [US62286487 \[0001\]](#)
- [US20050186108A1 \[0007\]](#)

Patentkrav

- 1.** Fremgangsmåde til desinficering af en landbrugsbygning omfattende flere rum, som er egnede til at modtage både dyr og mennesker, hvor mindst et rum af landbrugsbygningen inkluderer et belysningsystem omfattende et første
- 5 belysningselement, som tilvejebringer et første lys, og et andet belysnings-element, som tilvejebringer et andet lys, hvilken fremgangsmåde omfatter:
- overvågning af det mindst ene rum af landbrugsbygningen med en sensor for at detektere, at et menneske er til stede i det mindst ene rum;
- tilvejebringelse af det første lys i rummet med et første spektralindhold,
- 10 når mennesket er til stede; og
- tilvejebringelse af det andet lys i rummet med et andet spektralindhold inden for et smalt bølgelængdeområde for at hæmme bakterievækst, når mennesket ikke detekteres.
- 15 **2.** Fremgangsmåden ifølge krav 1, hvor det smalle bølgelængdeområde er mellem 410 nanometer og 450 nanometer.
- 3.** Fremgangsmåden ifølge krav 1, hvor det smalle bølgelængdeområde er mellem 100 nanometer og 400 nanometer.
- 20 **4.** Fremgangsmåden ifølge krav 1, hvor det smalle bølgelængdeområde er i et blåt bølgelængdeområde.
- 5.** Fremgangsmåden ifølge krav 1, hvor sensoren er en bevægelsesdetektor.
- 25 **6.** Fremgangsmåden ifølge krav 1, yderligere omfattende:
- overvågning af det mindst ene rum med en hjælpesensor; og
- tilvejebringelse af det andet spektralindhold baseret på en miljøtilstand af rummet detekteret med hjælpesensoren.
- 30 **7.** Fremgangsmåden ifølge krav 6, hvor hjælpesensoren detekterer mindst en af: luftfugtighed, temperatur, en bakterie, en virus og et forudbestemt kemikalie.

- 8.** Fremgangsmåden ifølge krav 1, hvor det første lys tilvejebringes af en lysemitterende diode.
- 9.** Fremgangsmåden ifølge krav 1, yderligere omfattende udladning af ozon i det 5 mindst ene rum i et forudbestemt tidsrum, når mennesket ikke detekteres.
- 10.** Fremgangsmåden ifølge krav 9, hvor ozonen udlades via koronaudladning.
- 11.** Fremgangsmåden ifølge krav 1, hvor det første spektralindhold og det andet 10 spektralindhold er forskellige.

DRAWINGS

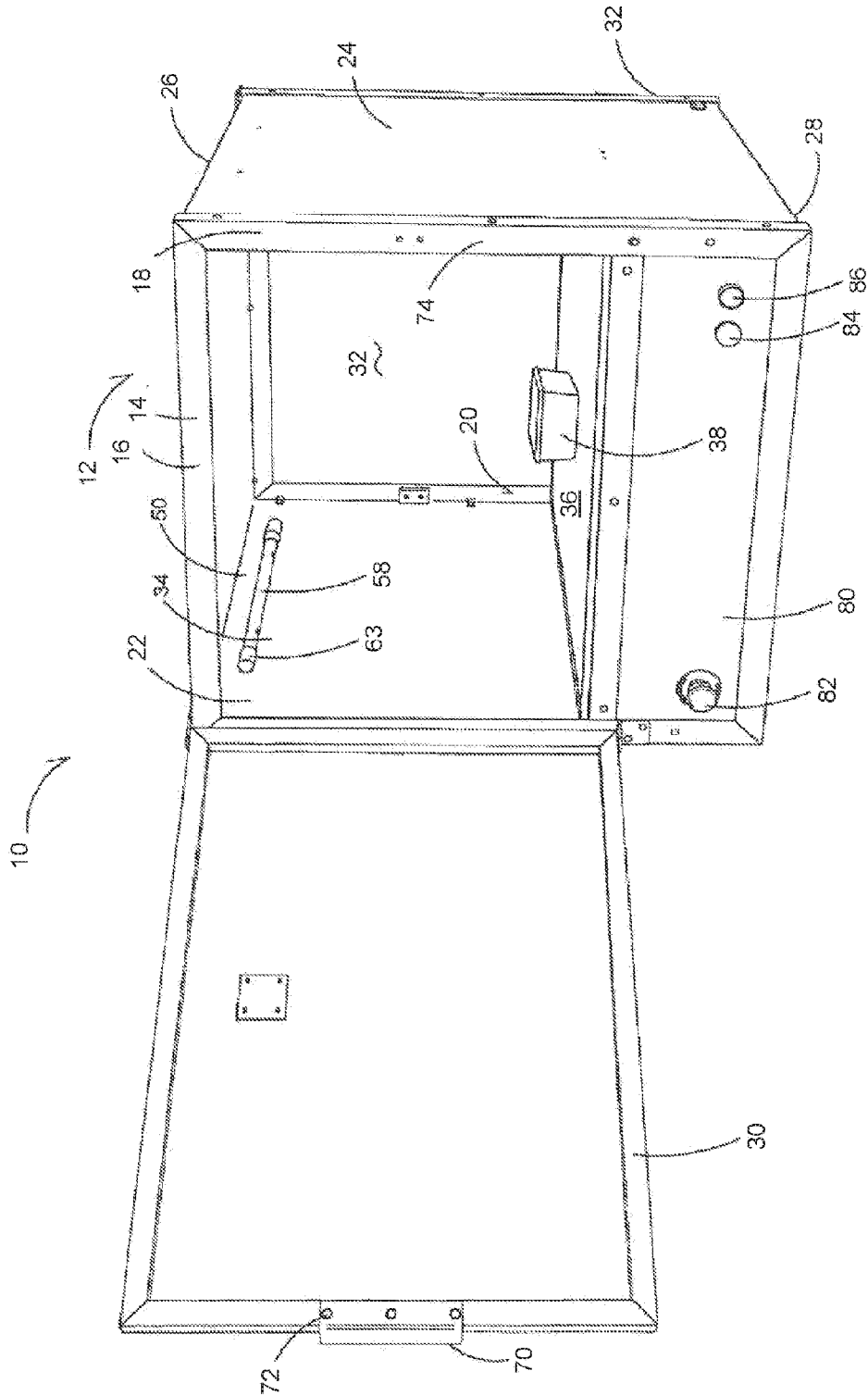


FIG. 1

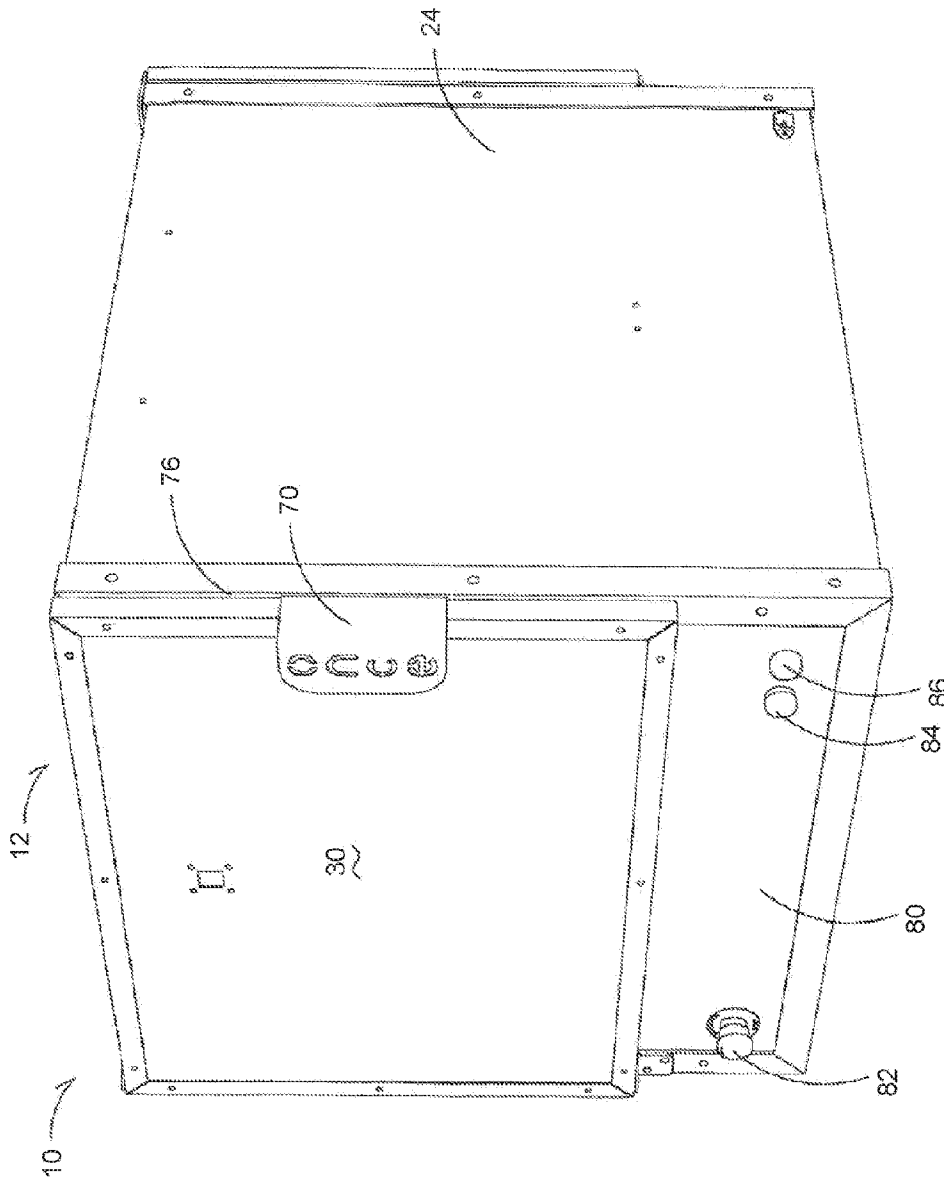


FIG. 2

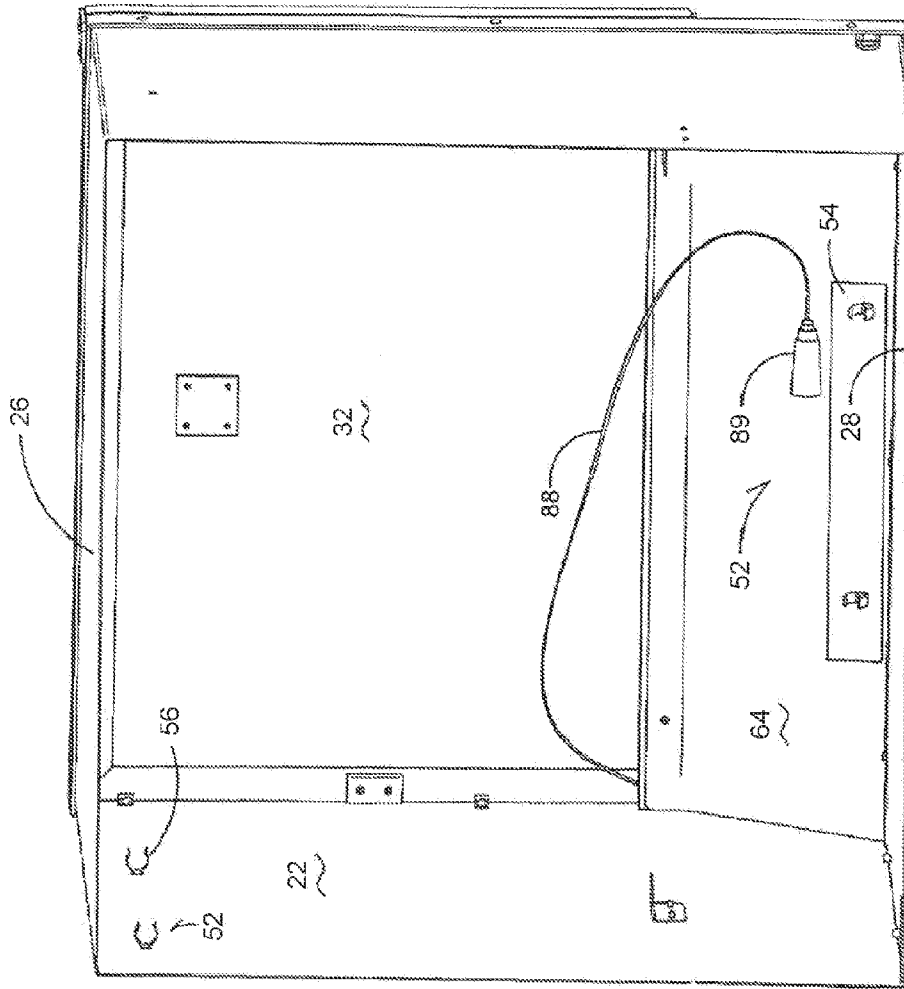


FIG. 3

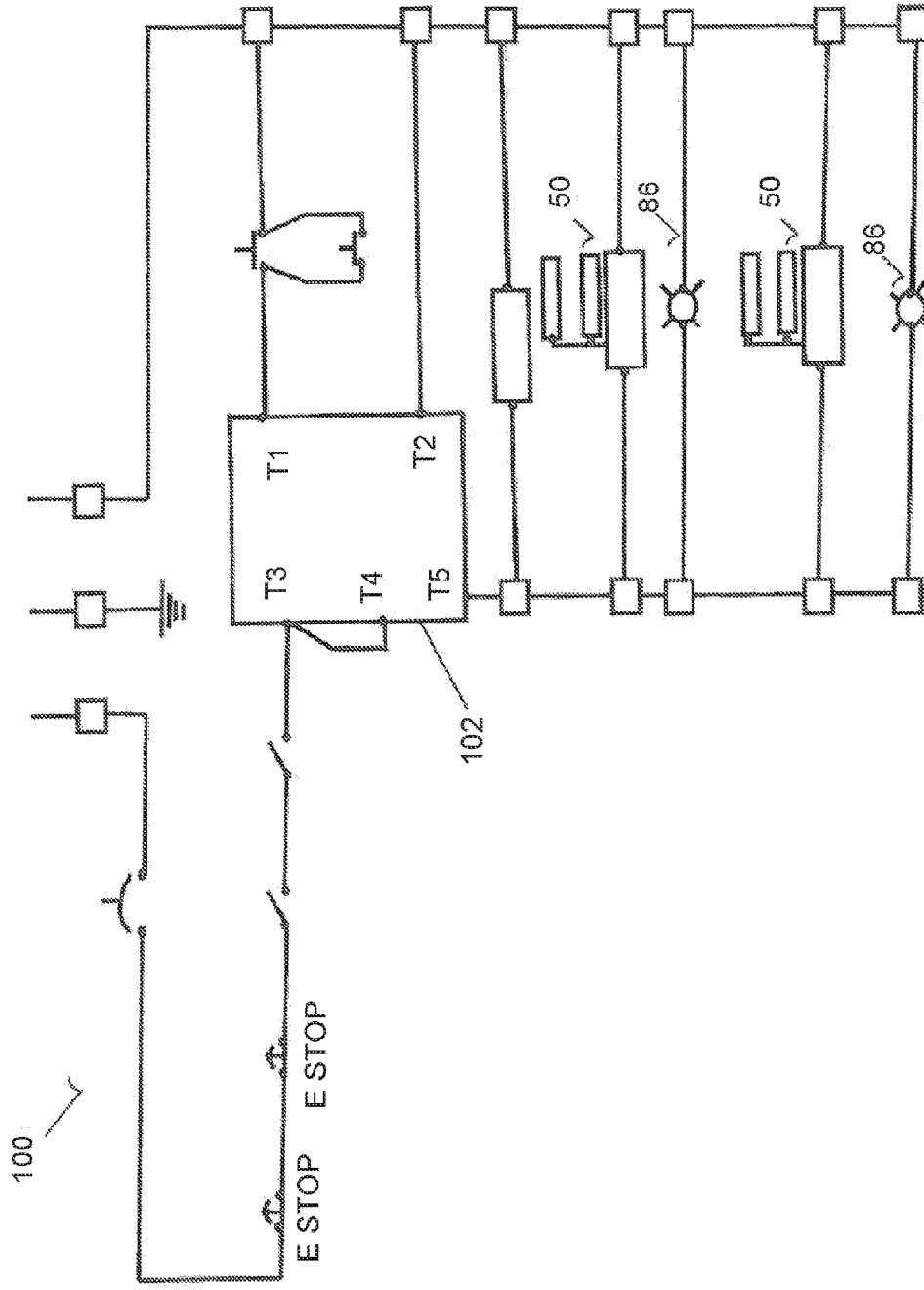


FIG. 4

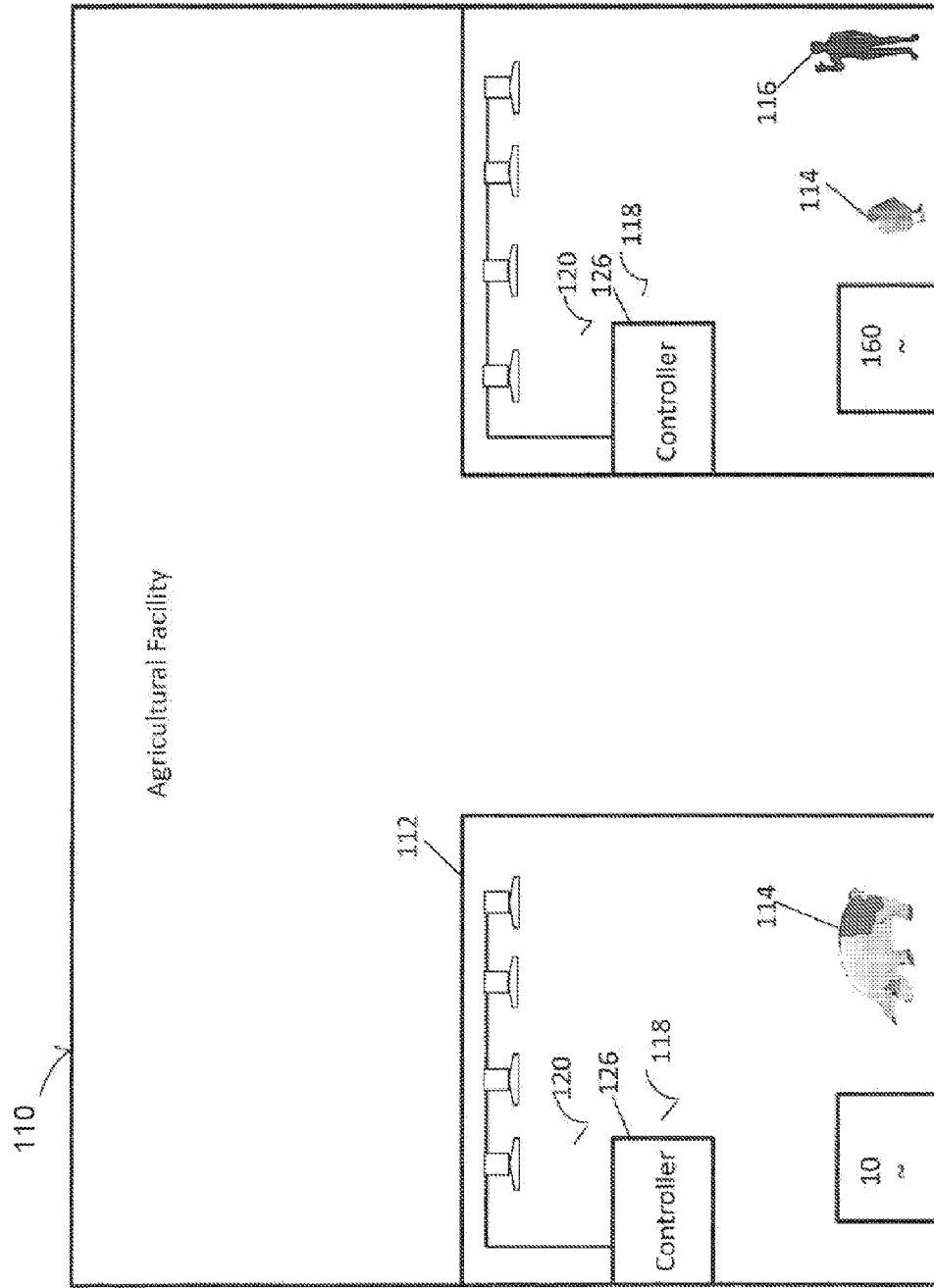


FIG. 5

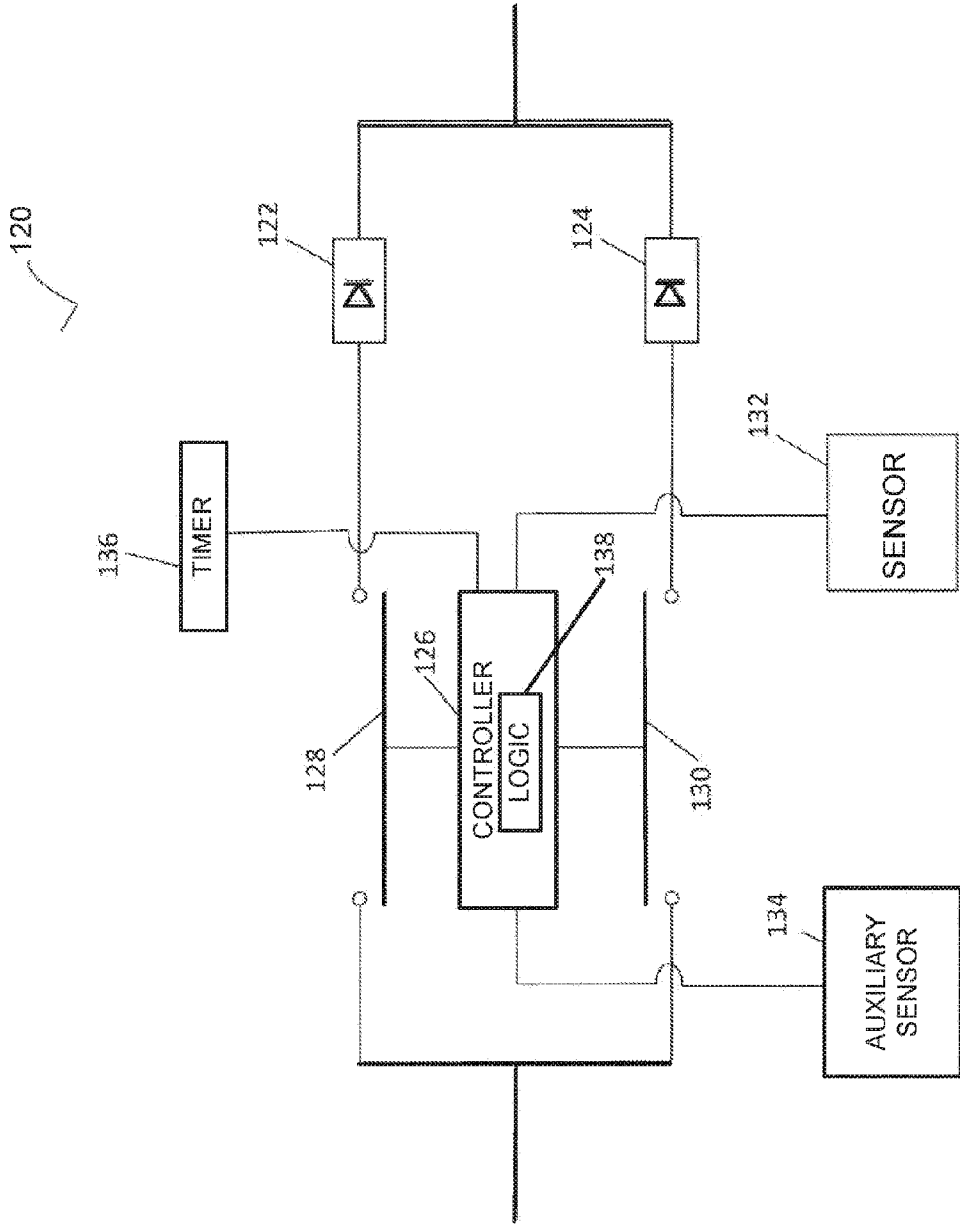


FIG. 6

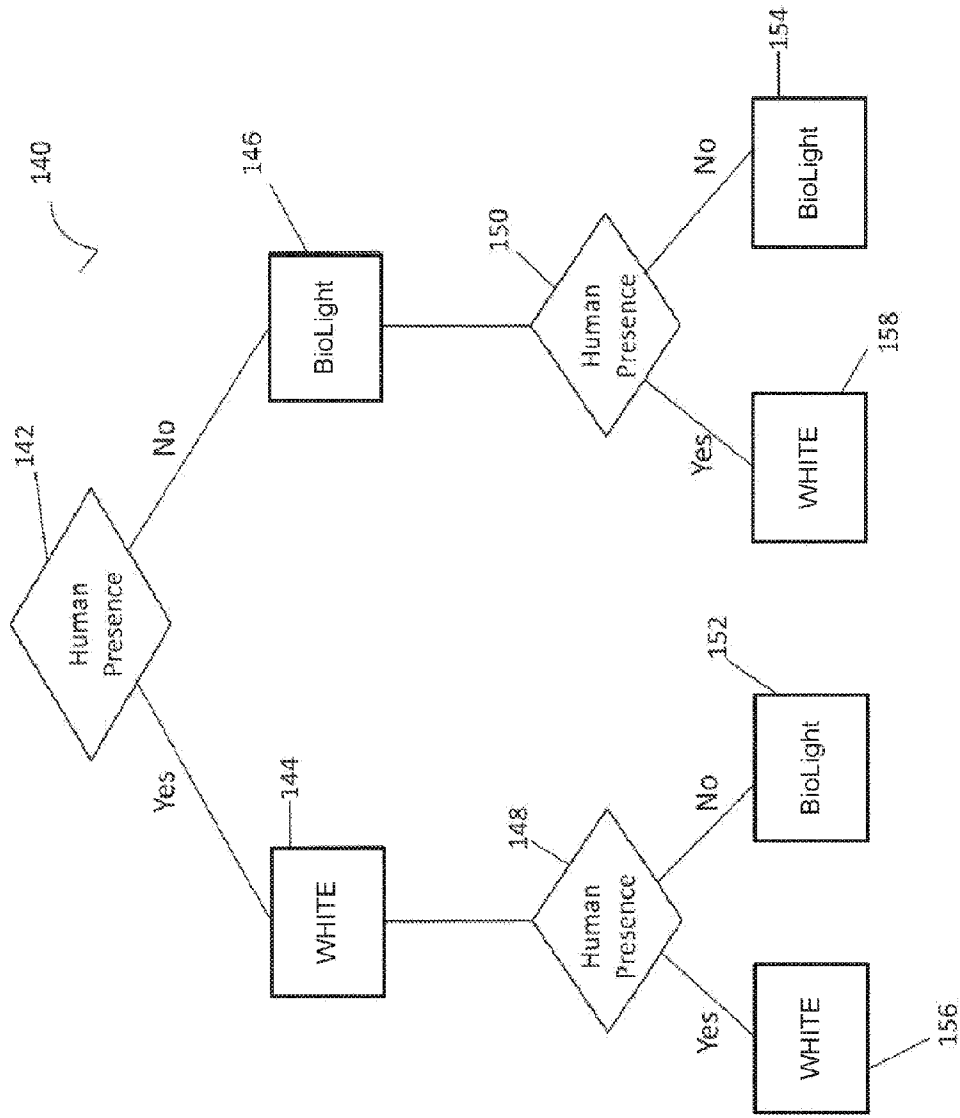


FIG. 7

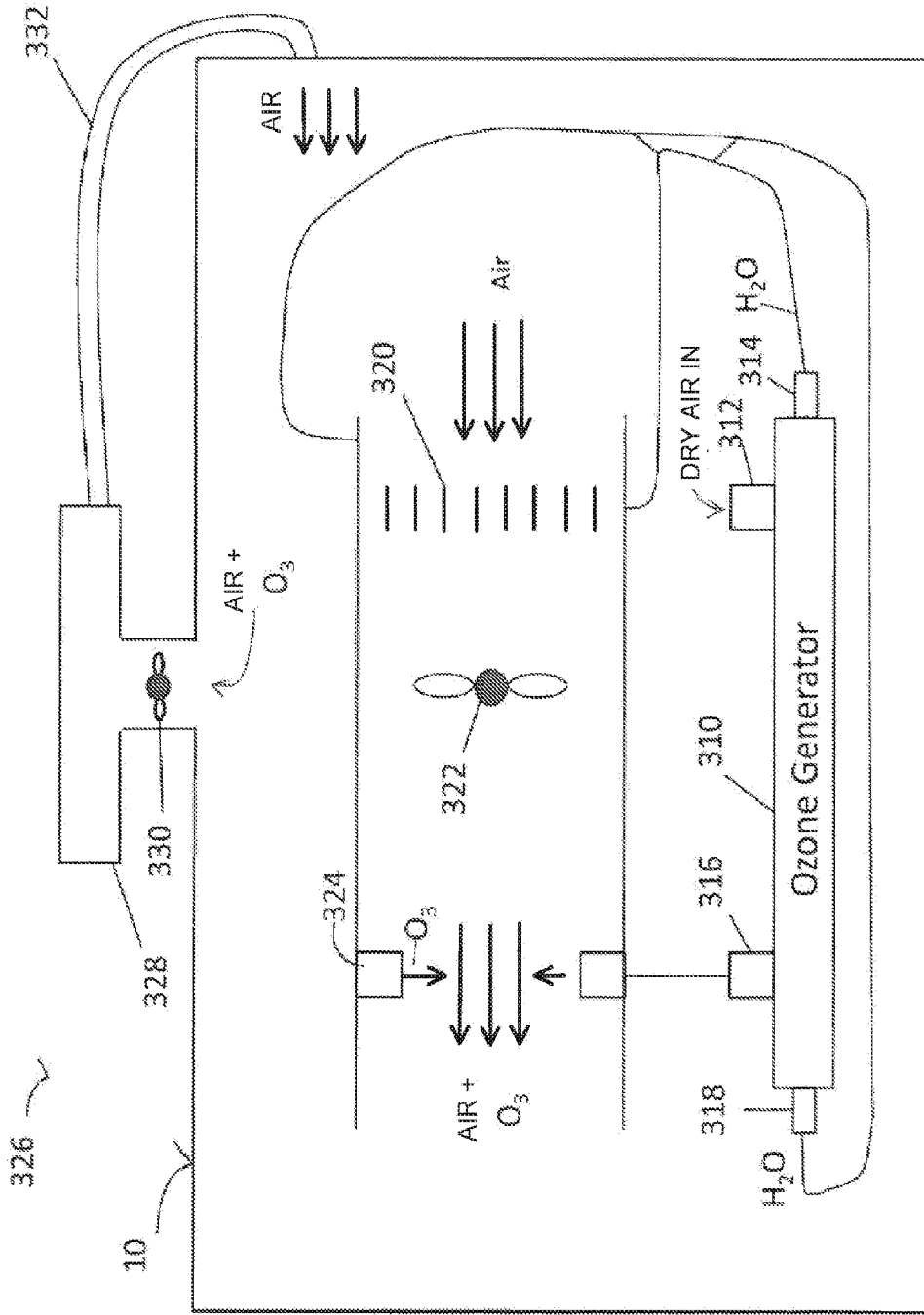


FIG. 8

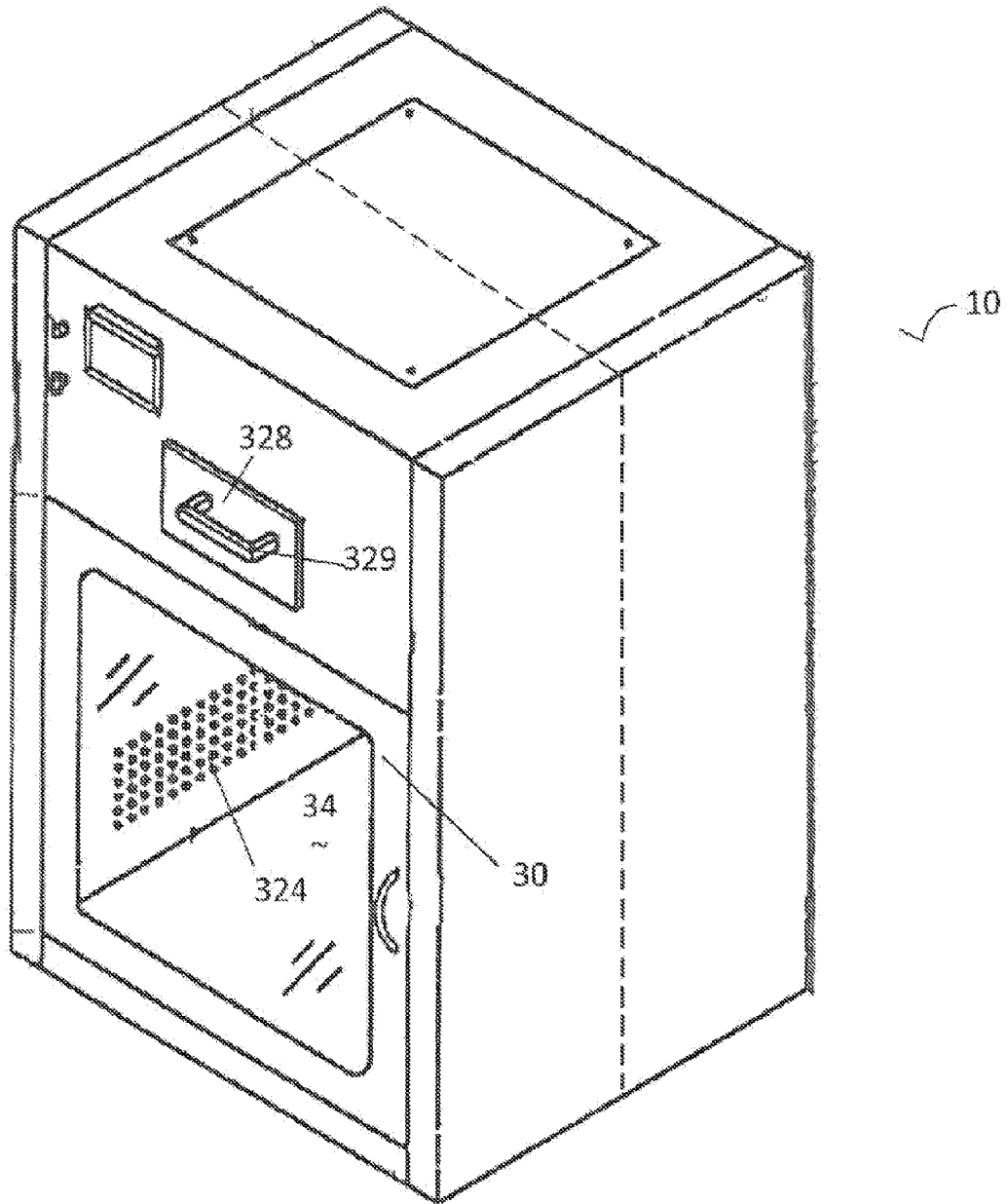


FIG. 9

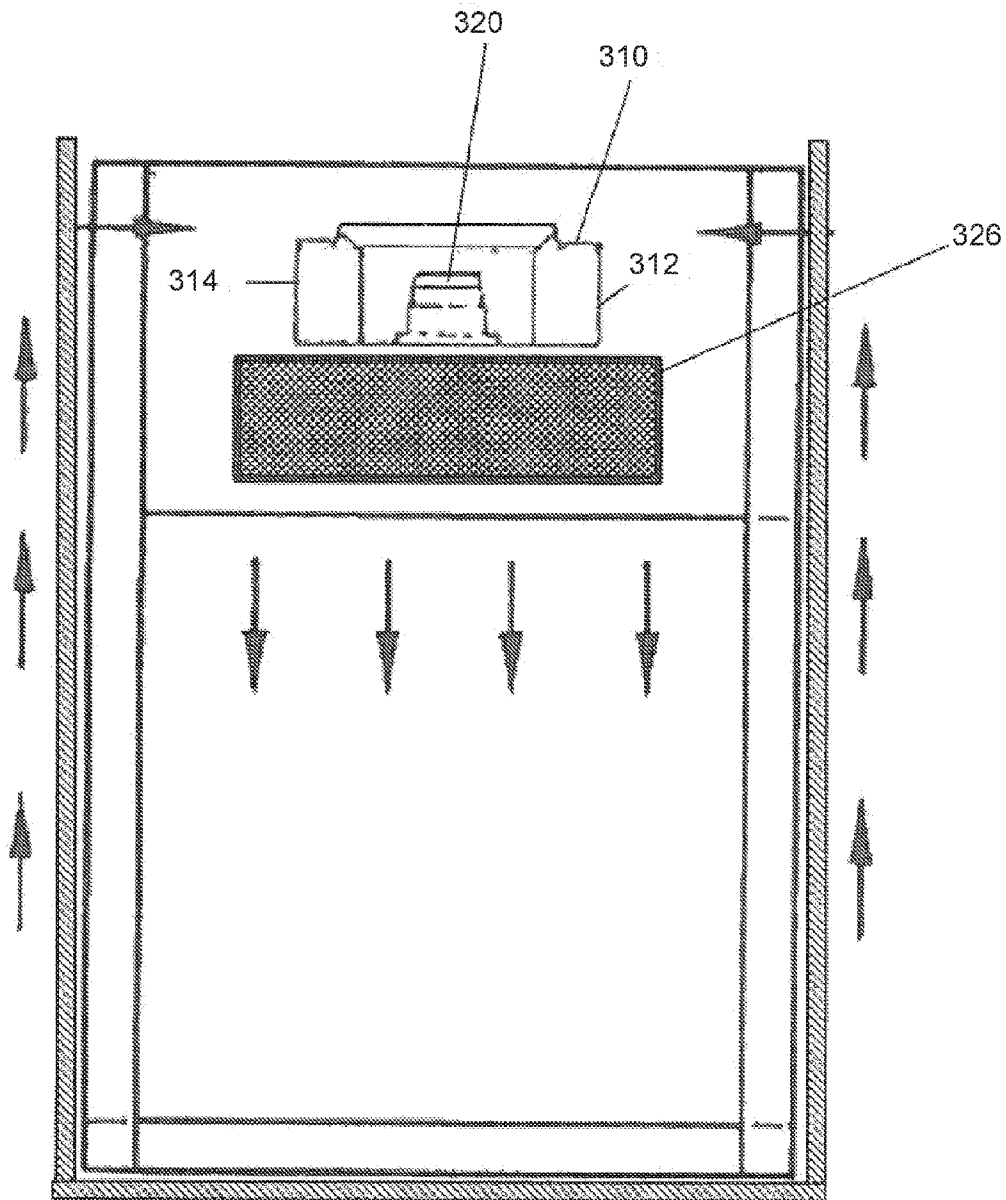


FIG. 10