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(54) Title: A HOME APPLIANCE KEEPING PRODUCE AS FRESH FOR A LONG TIME AND A METHOD USED IN THE
HOME APPLIANCE

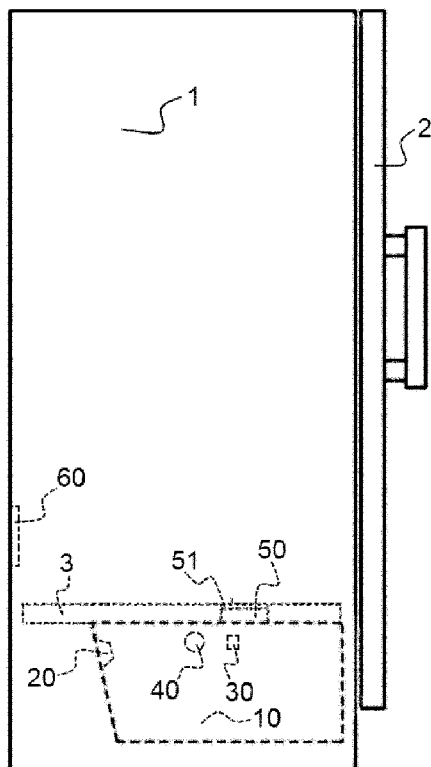


Figure 1

(57) Abstract: The invention is a home appliance (1) comprising a chamber (10), where a produce is placed, and an ozone source (20) in connection with the chamber (10) and is a method to keep a produce as fresh for a long time. The chamber (10) comprises an ethylene sensor (30) detecting ethylene gas in the chamber (10); a humidity sensor (40) detecting humidity amount in the chamber (10); a passage (50) allowing air exchange between inside and outside of the chamber (10) in a controllable manner; and a controller (60) controlling the ozone source (20) according to ethylene detection in the chamber (10) and controlling the passage (50) according to humidity amount in the chamber (10).

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SPECIFICATION

A HOME APPLIANCE KEEPING PRODUCE AS FRESH FOR A LONG TIME AND A METHOD USED IN THE HOME APPLIANCE

TECHNICAL FIELD

The present invention relates to a home appliance wherein produce is disposed and comprising a chamber in connection to an ozone generator. The present invention is particularly a domestic refrigerator comprising a crisper connected to an ozone generator.

PRIOR ART

Fresh produce, particularly fresh vegetable and fruit, continue to ripen in a rapid manner after being harvested, and begin deteriorating after certain while. If the atmosphere of the produce has a low temperature, the deterioration process is retarded. For this reason, fresh produces are generally kept in cooling devices.

However, in cooling devices comprising a closed chamber, the ethylene gas, released from fresh vegetables and fruits, may accumulate. The ethylene gas accumulated leads to acceleration of the deterioration of the produce.

In the related art, the produces are subjected to ozone gas during keeping thereof. The ozone gas may provide elimination of the organisms or chemicals which may exist on the produce or may provide elimination of the harms of the organisms or chemicals. Moreover, the ozone gas reacts with said ethylene gas in the reaction with number (I) described below, and oxidizes ethylene and provides carbon-dioxide and water formation.



On the other hand, the water formed as a result of the reaction with number (I) increases the humidity in the chamber. Excess humidity may relatively accelerate the deterioration process.

As an example to a home appliance using said method, the document with publication number US2013/0059047 A1 can be given. In said application, a crisper drawer is disclosed for postponing postharvest produce deterioration and disposed to a domestic refrigerator.

The chamber within the drawer is cooled by the refrigerator. An ozone generator provides gaseous ozone to the chamber. An ethylene scrubber reduces levels of ethylene in the chamber. The ozone level is controlled by a controller.

OBJECT OF THE INVENTION

The main object of the present invention is to provide a home appliance providing keeping of produce like vegetable and fruit as fresh for a long time.

In order to realize said object, the present invention relates to a home appliance comprising a chamber, where a produce is placed, and an ozone source in connection with the chamber. The present invention is characterized in that the chamber comprises an ethylene sensor detecting ethylene gas in the chamber; a humidity sensor detecting humidity amount in the chamber; a passage allowing air exchange between inside and outside of the chamber in a controllable manner; and a controller controlling the ozone source according to ethylene detection in the chamber and controlling the passage according to humidity amount in the chamber. Thus, the ethylene which accelerates deterioration of produce after a certain amount is oxidized with ozone thanks to the abovementioned reaction, and is transformed into carbon dioxide and water. Moreover, when the amount of humidity released by the produce and formed additionally as a result of the reaction rises above the suitable amount, it is decreased to a suitable amount by automatically providing air exchange with the outside of the chamber. Additionally, the respiration of the vegetables and fruits because of the carbon-dioxide formed in the reaction and thus the deterioration speed are decreased. As a result, the required suitable atmosphere for reducing deterioration of the produce is provided inside the chamber. In order to provide this, the amount of humidity and ethylene inside the chamber is continuously controlled.

In the present invention, said produce may be any produce deteriorating in short time in open air. The probable produce may be fresh fruits and vegetables. The home appliance used in the present invention may be a cooling home appliance, particularly a refrigerator, and particularly a domestic refrigerator. However, in the present art, it may be another known home appliance wherein produce is stored. In case the home appliance is a refrigerator, the chamber may be a crisper. In a probable embodiment, the home appliance comprises a chamber configured such that the inner atmosphere of the chamber is isolated from the outside atmosphere of the chamber in a controllable manner. Thus, the atmosphere inside the chamber is not affected by the external effects when not desired, and a complete control

is provided. However, there may be a negligible air exchange between the chamber inner atmosphere and the outside atmosphere. The chamber may be obtained from a material which is resistant to oxidization. However, in a probable embodiment of the present invention, since the amount of ozone is determined according to the ethylene amount, the effect of ozone on the oxidization of the chamber will be zero or very low. Therefore, the chamber may also be obtained from other materials known in the related art.

The ozone source is an ozone generator. The ozone generator may be positioned inside or outside of the chamber. When the ozone generator is positioned outside of the chamber, a mechanism may be used providing the produced ozone to be transferred into the chamber. The mechanism may comprise a pipe and isolation elements. The ozone generator positioned inside the chamber may produce ozone by means of a method known in the related art. For instance, it may be a generator using light (UV, etc.) or electrical field for separating the oxygen molecules in the air into the atoms thereof.

The ethylene sensor may be an ethylene sensor known in the related art. For instance, in a probable embodiment, an ethylene sensor may be used which is recently known to be cost-effective in the present art and comprising nanotubes (Esser B, et al., 2012) having copper atoms therein to bind with an ethylene molecule. The ethylene sensor may be positioned in the chamber. However, it may also be positioned outside the chamber together with a mechanism which will detect the ethylene gas in the air inside the chamber.

The humidity sensor may be a humidity sensor known in the related art. For instance, in the present art, sensors may be utilized which are used in the tests of the cooling devices. The sensor may be a sensor measuring a different value providing detection of the relative humidity or the amount of humidity inside the chamber. The humidity sensor may be positioned inside the chamber. However, it may also be positioned outside the chamber together with a mechanism which will detect the humidity in the air inside the chamber.

In a probable embodiment of the present invention, the passage comprises a mechanical or an electromechanical valve that is controllable in relation with humidity of air in the chamber. The valve is automatically controlled. Moreover, it may be additionally controlled manually. The passage may be a cover that is controllable in relation with humidity of inner air in the chamber. The cover may be opened in a closeable manner on a chamber wall. The cover may be a sliding cover on a wall or it may be a flap functioning by means of rotation around

an axis. The passage may also be obtained by providing temporarily malfunctioning of the isolation element or elements providing isolation of the chamber from the outside atmosphere. The passage may comprise a pipe whose air exchange with the outside atmosphere is controllable.

The controller may be a controller known in the related art and automatically controlling the ozone source according to ethylene detection in the chamber and controlling the passage according to humidity amount in the chamber. For instance, the controller may be an electronic circuit card. The ozone source may be in communication with the ethylene sensor, passage and humidity sensor. For instance, it may be connected to the elements related by means of the cables. One or more of the related connections may also be provided by means of wireless connections known in the related art. The controller may be positioned inside or outside the chamber optionally.

In order to reach said object, the present invention relates to a method of reducing postharvest produce deterioration comprising the steps of placing the produce in a chamber of a home appliance in connection with an ozone source. The present invention is characterized by comprising the further steps of:

- detecting ethylene gas in the chamber,
- providing ozone gas to the chamber by the ozone source following the detection of ethylene gas,
- maintaining humidity in the chamber at an optimal amount range.

Thus, ethylene, which accelerates produce deterioration after certain amount, is oxidized with ozone thanks to the abovementioned reaction, and it is transformed into carbon-dioxide and water. Moreover, when the amount of humidity released from the produce and additionally formed as a result of reaction rises above the suitable amount, it is decreased automatically to a suitable amount by providing air exchange with the outside atmosphere of the chamber. Additionally, the respiration of the produce due to carbon-dioxide obtained additionally in the reaction, and thus the deterioration speed are decreased. As a result, the required suitable atmosphere for retarding produce deterioration is provided inside the chamber.

In a probable application of the present invention, the step of maintaining humidity in the chamber comprises steps of detecting humidity of air in the chamber; opening a passage of

the chamber allowing air exchange between inside and outside of the chamber by a controller following detection of humidity in the chamber; and closing the passage by the controller following reduction of the humidity in the chamber to a predefined amount range. Thus, the atmosphere inside the chamber is brought to the required suitable form automatically for retarding deterioration of the produce.

Chamber temperature may be at room temperature or at a lower temperature. For instance, it may be 4-8 °C.

The ethylene gas is detected by means of an ethylene sensor as described above. The detectable amount of ethylene may fall until approximately 0.5 ppm (part per million) or it is higher than 0.5 ppm. The ethylene sensors provided in the present art are compliant to this value.

Substantial amount of ozone is provided inside the chamber in order for the detected ethylene to be transformed into carbon-dioxide and water. Here, the amount can be provided as 2 moles of ozone for each mole of ethylene in a compliant manner to the reaction coefficients. Calculations are realized according to the operation speed and production capacity of the ozone source, and the ozone source may provide ozone for certain duration. The ozone inside the chamber may be consumed completely by means of the reaction. Ozone may be provided in a greater amount in a compliant manner to the limit values in the related regulations. For instance, approximately maximum 0.01 ppm ozone may be provided inside the chamber. By means of this, the disinfecting and deodorizing effect of ozone may also be used.

The humidity is detected by a humidity sensor as described above. The maintained humidity may be relative humidity. The maintained relative humidity in the chamber ranges from about 70% to 100%. For instance, the relative humidity may be approximately maintained between 95-98 %.

BRIEF DESCRIPTION OF THE FIGURES

In Figure 1, the left lateral view of the home appliance is given. The home appliance is a domestic refrigerator. The door of the refrigerator is in closed position. The representative view and position of the chamber, ozone generator, humidity and ethylene sensors, passage, passage valve and controller according to a probable embodiment of the present invention

are described with dashed lines. The transmission elements like cable, etc. providing connection between the controller and the other elements are not illustrated in the figure.

In Figure 2, the representative isometric view of a shelf compliant to a probable embodiment of the present invention and corresponding to the chamber top is given. The controller and the cable used in the present invention are not illustrated in the figure.

In Figure 3, the representative isometric view of a chamber compliant to a probable embodiment of the present invention is given. Inside the chamber, the ozone generator, humidity sensor and ethylene sensor are illustrated in a representative manner. In the shelf, the representative passage and passage valve are exemplified. The controller and the communication elements like the cable used in the present invention are not illustrated in the figure.

In Figure 4, the flow diagram representing the control of the ethylene amount inside the chamber is illustrated.

In Figure 5, the flow diagram representing the control of the amount of humidity inside the chamber is illustrated.

THE DETAILED DESCRIPTION OF THE INVENTION

The direction statements described in this document like front, upper and lower, are described by referencing the visible wall of the home appliance (1) provided in Figure 1 as the "left" and by referencing the wall where the door (2) is provided as the "front". One or a number of the probable embodiments of the present invention is described in detail below.

The present invention is a home appliance (1) like a domestic refrigerator whose representative view is given in Figure 1. The refrigerator is viewed from the left lateral side. It has a single door (2) and the door (2) thereof is in closed position. The chamber (10) called crisper and wherein produce like fresh vegetables and fruits are disposed is positioned to the bottom part of the inner chamber of the refrigerator.

The chamber (10) is in the form of a drawer. Therefore, it does not have an upper wall. As the upper wall, there is generally a shelf (3) thereon. The shelf (3) and the chamber (10) are related so as to provide the inside of the chamber (10) to be at least partially isolated from the outside of the chamber (10).

On a wall inside the chamber (10), an ozone generator is positioned as the ozone source (20) (Figure 3). The wall can be the rear wall of the chamber (10). Inside the chamber (10),

an ethylene sensor (30) and a humidity sensor (40) can be positioned on the same wall or on a different wall.

On the shelf (3), a passage (50) is formed for providing air exchange with the inside and outside of the chamber (10). The passage (50) can be covered or opened by means of a cover (51). The probable cover (51) presented in Figure 2 can be moved on the shelf (3) in a sliding manner. Thus, the passage (50) is controlled. The cover (51) can be controlled manually when desired by means of a handle (511) provided on the cover (51).

The electronic circuit board used as the controller (60) is positioned at a suitable point of the refrigerator. In Figure 1, the controller (60) is fixed to the rear wall of the refrigerator. The communication between the ethylene sensor (30) and the passage cover (51) and the humidity sensor (40), the ozone source (20) and the controller (60) is provided by means of cables. However, the cables are not illustrated in Figure 1 or Figure 2.

In a probable arrangement of the method provided by the present invention (Figure 4 and Figure 5):

- First of all, the fresh vegetable or fruit, desired to be kept fresh, is located inside the chamber (10);
- The chamber (10) is positioned in place while the passage cover (51) is in closed form;
- When the ethylene, released by the vegetables or fruits inside the chamber (10), reaches the level of 0.5 ppm, this value is detected by the ethylene sensor (30) and is transferred to the controller (60) for being compared with the reference value;
- The ozone source (20) is activated by the controller (60) for releasing ozone gas, having a level compliant to reaction with number (I), to the chamber (10);
- Meanwhile, the amount of humidity inside the chamber (10) is detected by the humidity sensor (40) and is compared with the reference humidity amount in the controller (60);
- When the humidity exceeds the limit level of 95-98 %, the passage cover (51) is opened by the controller (60) and air exchange is allowed;
- When the humidity is reduced to the ideal amount range, the passage cover (51) is closed by the controller (60);

- Depending on the ethylene measurement realized meanwhile, the controller (60) deactivates the ozone source (20) and the ozone gas production is stopped;
- As a result, the ethylene density, which accelerates deterioration, is kept at ideal values. Moreover, the humidity, occurring as a result of the reaction formed for delimiting ethylene density, and the continuously changing humidity level are maintained at suitable values.

References

1. Esser, B., Schnorr, J. M. and Swager, T. M. (2012), Selective Detection of Ethylene Gas Using Carbon Nanotube-based Devices: Utility in Determination of Fruit Ripeness. *Angew. Chem. Int. Ed.*, 51: 5752–5756.

REFERENCE NUMBERS

1. Home appliance
2. Door
3. Shelf

10. Chamber
20. Ozone source
30. Ethylene sensor
40. Humidity sensor
50. Passage
51. Cover
511. Handle
60. Controller

CLAIMS

1. A home appliance (1) comprising a chamber (10), where a produce is placed, and an ozone source (20) in connection with the chamber (10) and **characterized in that** the chamber (10) comprises an ethylene sensor (30) detecting ethylene gas in the chamber (10); a humidity sensor (40) detecting humidity amount in the chamber (10); a passage (50) allowing air exchange between inside and outside of the chamber (10) in a controllable manner; and a controller (60) controlling the ozone source (20) according to ethylene detection in the chamber (10) and controlling the passage (50) according to humidity amount in the chamber (10).
2. A home appliance (1) according to claim 1; wherein the ozone source (20) is an ozone generator.
3. A home appliance (1) according to anyone of the preceding claims; wherein the ethylene sensor (30) comprises a nanotube having copper atoms therein to bind with an ethylene molecule; or a combination thereof.
4. A home appliance (1) according to anyone of the preceding claims; wherein the humidity sensor (40) is a sensor to detect relative humidity.
5. A home appliance (1) according to anyone of the preceding claims; wherein the home appliance (1) comprises a chamber (10) configured such that the inner atmosphere of the chamber (10) is isolated from the outside atmosphere of the chamber (10) in a controllable manner.
6. A home appliance (1) according to anyone of the preceding claims; wherein the passage (50) comprises a valve that is controllable in relation with humidity of air in the chamber (10).
7. A home appliance (1) according to anyone of the preceding claims; wherein the passage (50) comprises a cover (51) that is controllable in relation with humidity of air in the chamber (10).
8. A home appliance (1) according to anyone of the preceding claims; wherein the chamber (10) is a crisper.

9. A home appliance (1) according to anyone of the preceding claims; wherein the home appliance (1) is a refrigerator, especially a domestic refrigerator.

10. A method of reducing postharvest produce deterioration comprising the steps of placing the produce in a chamber (10) of a home appliance (1) in connection with an ozone source (20); and **characterized** by comprising the further steps of:

- detecting ethylene gas in the chamber (10),
- providing ozone gas to the chamber (10) by the ozone source (20) following the detection of ethylene gas,
- maintaining humidity in the chamber (10) at an optimal amount range.

11. A method according to claim 10; wherein the step of maintaining humidity in the chamber (10) comprises steps of detecting humidity of air in the chamber (10); opening a passage (50) of the chamber (10) allowing air exchange between inside and outside of the chamber (10) by a controller (60) following detection of humidity in the chamber (10); and closing the passage (50) by the controller (60) following reduction of the humidity in the chamber (10) to a predefined amount range.

12. A method according to claim 10 or 11; wherein the maintained humidity is relative humidity.

13. A method according to claim 12; wherein the maintained relative humidity in the chamber (10) ranges from about 70% to 100%.

14. A method according to any one of claims 10-13; wherein the detected ethylene amount in the chamber (10) is about 0.5 ppm or higher.

15. A method according to any one of the claims 10-14; wherein ozone is provided such that the chamber (10) comprises up to about 0.1 ppm ozone.

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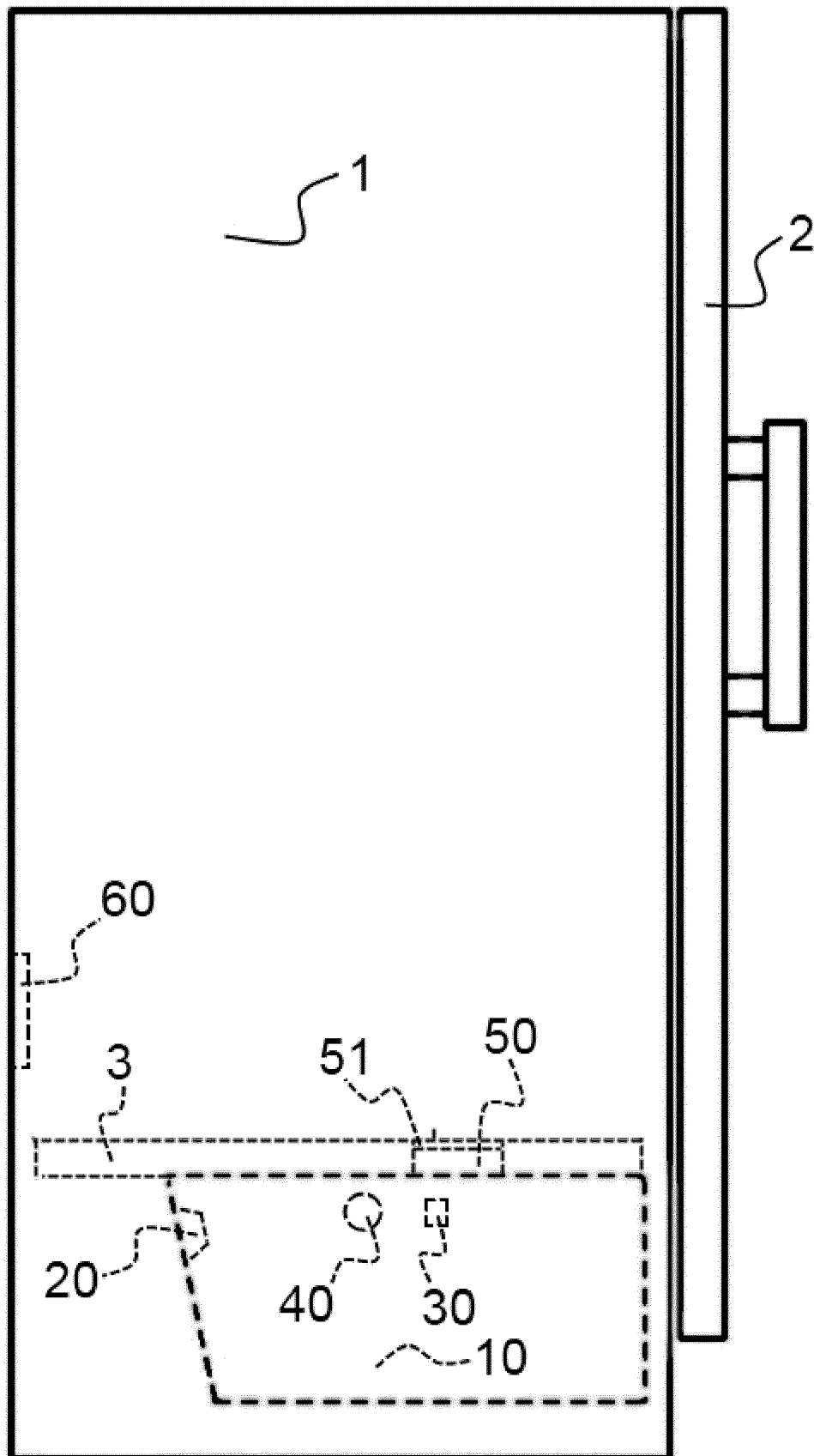


Figure 1

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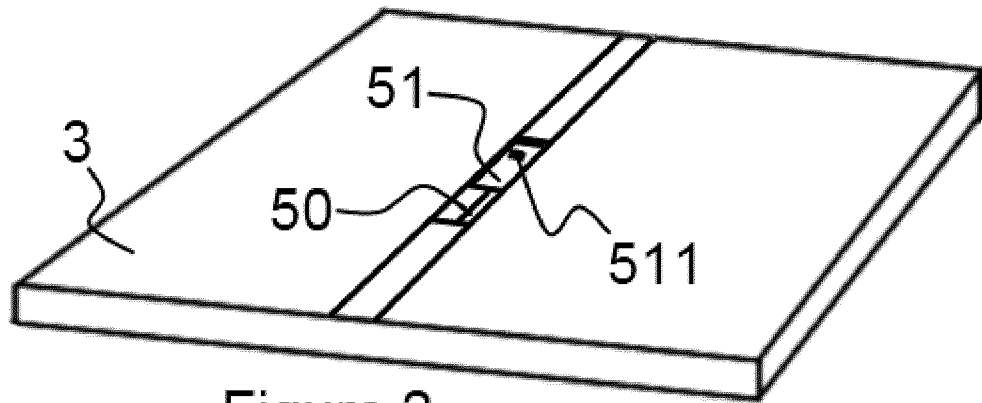


Figure 2

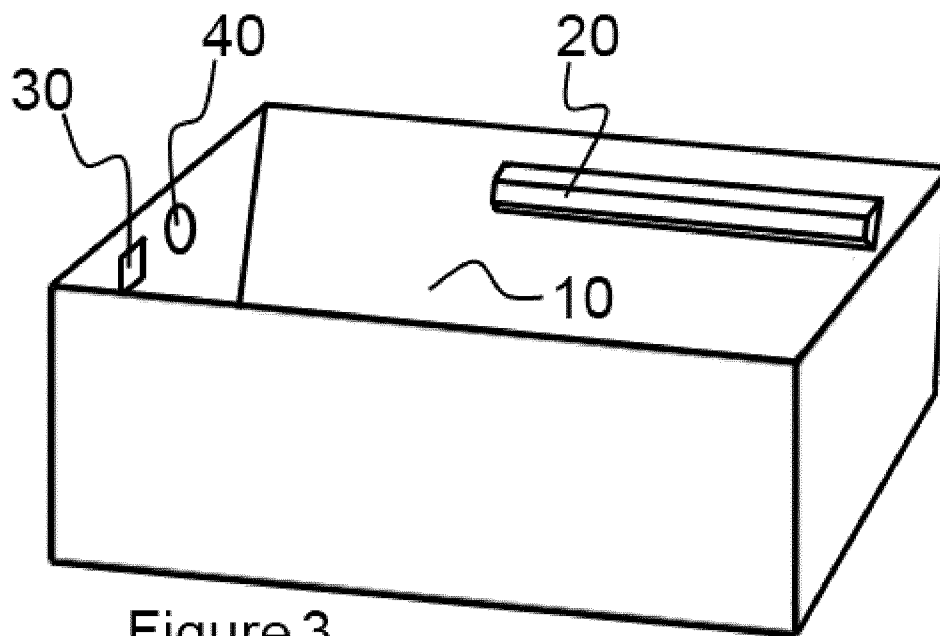


Figure 3

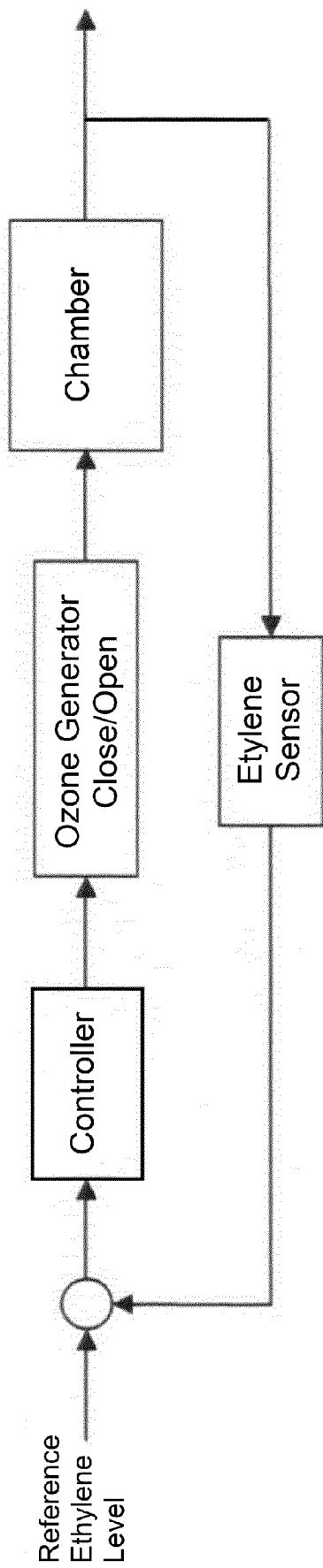


Figure 4

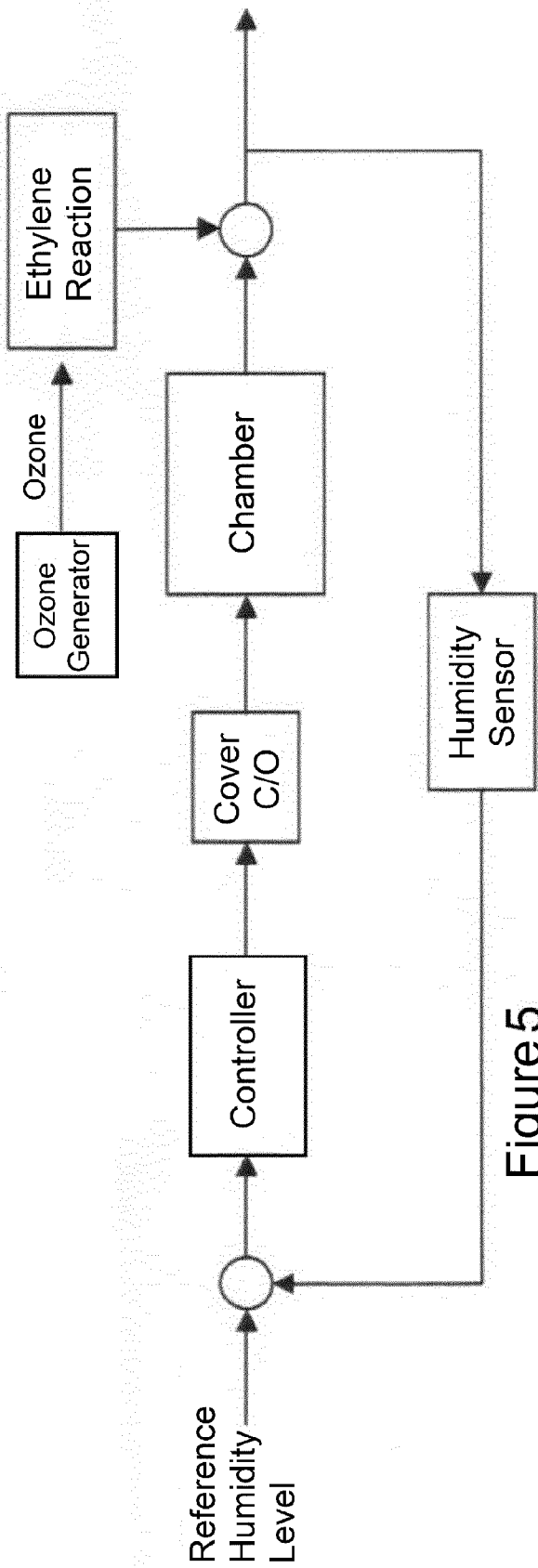


Figure 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2014/055618

A. CLASSIFICATION OF SUBJECT MATTER
INV. F25D17/04
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F25D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2013/059047 A1 (ARRIGO VINCENT M [US]) 7 March 2013 (2013-03-07) cited in the application paragraphs [0005] - [0052]; figures 1-3, 5, 6	1-15
X	US 2006/130498 A1 (JOSHI ANAND G [IN] ET AL JOSHI ANAND GANESH [IN] ET AL) 22 June 2006 (2006-06-22) paragraphs [0013] - [0043]; figures 1-5	1-15
X	US 2012/198862 A1 (ARRIGO VINCENT M [US]) 9 August 2012 (2012-08-09) paragraphs [0010] - [0064]; figures 1-7	1-15



Further documents are listed in the continuation of Box C.



See patent family annex.

* Special categories of cited documents :

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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

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Date of the actual completion of the international search

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28/05/2014

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/EP2014/055618

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2013059047	A1	07-03-2013	NONE
US 2006130498	A1	22-06-2006	NONE
US 2012198862	A1	09-08-2012	NONE