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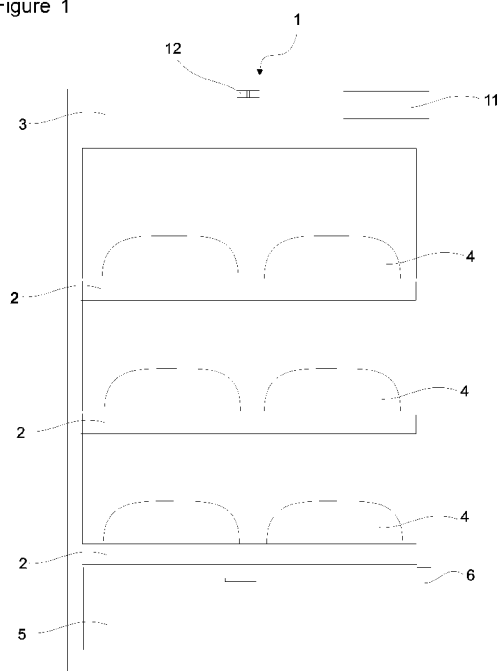
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(54) Title: LIQUID LEAKAGE DETECTION METHOD IN PLANT GROWING CABINETS

Figure 1



(57) Abstract: The present invention relates to a plant growing cabinet (1) comprising a body (3) in which at least one plant growing unit (2) is disposed, a plant growing tray (4) with a base of perforated structure, in which the mixture enabling the plants to grow is put, and placed on the plant growing unit (2) so as to form a first volume (V1) in between itself and the base of the plant growing unit (2), a liquid chamber (5) in liquid connection with the plant growing unit (2), in which the liquid solution required by the plants to grow is stored, a sensor (6) measuring the level of the liquid in the liquid chamber (5), a transmission tube (7) enabling fluid connection between the liquid chamber (5) and the plant growing unit (2), a transmission valve (8) enabling the liquid to be transmitted to the plant growing unit (2), a discharge tube (9) discharging to the liquid chamber (5) the excess liquid remaining in the plant growing unit (2) after being absorbed by the mixture, and a discharge valve (10) connecting the discharge tube (9) to the plant growing unit (2).

Description

LIQUID LEAKAGE DETECTION METHOD IN PLANT GROWING CABINETS

- [0001] The present invention relates to a plant growing cabinet used for growing plants. The present invention particularly relates to a domestic type plant growing cabinet.
- [0002] Hydroponic cultivation is a method of agriculture based on growing plants without soil, and depends on the principle of giving water and the nutrients required by the plants, to the root environment in required amounts, and is practiced in water or solid medium culture. The plants to be grown in soilless agriculture applications are cultivated in an enclosed environment in which the levels of water, light, humidity and carbon dioxide in the air, which has a significant part in growing of a plant, is maintained constant. During growing of a plant, all these elements are optimized according to the phase of the plant's growth, and the plant is thus enabled to grow more rapidly and is protected from harmful outer environment elements (e.g. high levels of humidity, light intensity). During watering, the micro particles contained in turf or similar mixtures used in plant growing cabinets may collect on the base of the plant growing unit by means of holes involved in introducing a nutrient liquid into the plant growing tray, provided under the plant growing tray in which the plant and the turf mixture is disposed. Blockages may occur during discharging of the liquid back to the main reservoir, and as a consequence the liquid collecting on the plant growing tray may cause the roots of the plants to deteriorate, and may therefore lead to irreversible permanent damages on the plants.
- [0003] State of the art U.S. patent document no. US 8,549,788 B2 discloses a domestic type plant growing cabinet.
- [0004] State of the art U.S. patent document no. USD 659,724 S1 discloses a domestic type plant growing cabinet.
- [0005] The aim of the present invention is to inhibit liquid leakage from a plant growing cabinet to its surroundings by preventing liquid leakage forming due to blockages likely to occur during the liquid cycle of plant growing cabinets, and therefore to enhance the quality perception of the product by obviating material damages of the user.

[0006] The plant growing cabinet realized to achieve the aim of the present invention and disclosed in the first claim and the dependent claims, is provided with plant growing units positioned in the body. Plant growing trays in which plants are planted and containing the turf mixture in which plants grow, are placed into said plant growing units. Liquid solution is pumped according to the humidity level of the turf mixture from the plant tray provided in the plant growing unit to the plant growing units. The difference in the level of the liquid solution can be measured before and after pumping by means of a sensor provided in the liquid chamber, and the liquid solution amount consumed during watering can thus be determined. Upon pumping from the liquid chamber, the liquid solution is transmitted to the plant growing unit by passing through the transmission tube and the transmission valve, respectively. After the turf mixture reaching a desired humidity level, the liquid solution remaining is transmitted to the liquid chamber by passing through the discharge valve and the discharge tube, respectively. The base of the plant growing tray placed in the plant growing unit, is fixed at a position higher than the base of the plant growing unit. By this, a first volume (V_1) is formed between the plant growing unit and the plant growing tray. The volume of the liquid solution transmitted from the liquid chamber into the plant growing unit during transmission of the liquid solution for watering, is the second volume (V_2) and is greater than the first volume (V_1). The liquid solution enters into the plant growing tray thanks to the base of the plant growing tray having a perforated structure, and supplies the liquid needed by the plants being cultivated. In order to detect a liquid leakage, liquid solution of a third volume (V_3) which is less than the first volume (V_1) is transmitted by means of a pump from the liquid chamber into the plant growing unit. Said transmitted liquid solution is not absorbed by the turf disposed in the plant growing tray because it cannot reach the perforated base of the plant growing tray, and therefore is discharged to the liquid chamber. The liquid level of the liquid chamber before transmission and after discharge is measured by the sensor, and the obtained result is transmitted to the control unit. When the control unit detects a difference between said two

levels, it determines presence of liquid leakage or blockage in the plant growing cabinet. By this, the plants are prevented from being devoid of the liquid solution they need for growing due to blockage or liquid leakage, thereby avoiding damages on the plants. Another advantage of the invention is preventing liquid leakages arising from the plant growing cabinet, and therefore preventing the dwelling of the user from being damaged due to liquid leakage.

- [0007] In an embodiment of the invention, the plant growing cabinet comprises a control unit capable of transmitting liquid to separate plant growing units at different time periods. When the volume of the transmitted liquid is less than the first volume (V1) remaining between the plant growing unit and the plant growing tray, the liquid cannot be absorbed through the plant growing tray, and whether liquid leakage is present or not on the transmission tube and the discharge tube respectively transmitting and discharging liquid to said plant growing tray or the related plant growing unit, can thus be determined. By this, it becomes unnecessary to use more than one control unit, thereby improving costs.
- [0008] In an embodiment of the invention, the plant growing cabinet comprises a signaling means alerting the user visually or audibly when the control unit detects liquid leakage. The user is thus informed about a liquid leakage and is enabled to quickly intervene in said liquid leakage.
- [0009] In an embodiment of the invention, the plant growing cabinet comprises a transmission line volumetric flow meter provided between the transmission valve and the plant growing unit, measuring the volume of the liquid passing therethrough and transmitting the results to the control unit. By this, it can be determined whether a liquid leakage is present on the transmission line or plant growing unit and the discharge line. Consequently, the user is provided with precise information about the location of the liquid leakage, enhancing the perception of the product.
- [0010] In an embodiment of the invention, the plant growing cabinet comprises a discharge line volumetric flow meter provided between the discharge valve and the plant growing unit, measuring the volume of the liquid passing therethrough and transmitting the results to the control unit. By this, it can

be determined whether a liquid leakage is present on the discharge line or plant growing unit and the transmission line. The liquid cycle is segmented into 3 portions thanks to the control unit evaluating the data from the transmission line volumetric flow meter and the discharge line volumetric flow meter. The advantage here is the location of a liquid leakage being determined precisely and being informed to the user. The user's perception of the product is thus improved.

- [0011] In an embodiment of the invention, the plant growing cabinet comprises a control unit controlling the processes of liquid pumping and detection of liquid leakage. Liquid required for growing by the plants in the plant growing tray is transmitted into the plant growing unit by means of the control unit. For transmitting liquid to the roots of the plants, the control unit transmits liquid in an amount of second volume (V_2) which is greater than the first volume (V_1), and liquid thus reaching the plant roots at the base of the plant growing tray, feeds the plants. Liquid in the amount of the third volume (V_3) pumped for detecting liquid leakage, is transmitted to the plant growing unit, and is then immediately discharged back to the liquid chamber, and whether liquid leakage is present or not in the plant growing cabinet is thus determined. By this, the plant growing cabinet is controlled by one control unit, thereby improving costs.
- [0012] In an embodiment of the invention, the plant growing cabinet comprises a liquid chamber suitable for positioning out of the body. Space is thus saved in the internal volume of the product.
- [0013] In another embodiment of the invention, the plant growing cabinet comprises a sensor which can be used by being removed from the liquid chamber by the user. By this, the user can remove the sensor from the liquid chamber when he/she hasn't access the plant growing unit for long periods, and can use the removed sensor in a storage unit with a larger volume than the liquid chamber, and the plant growing cabinet can thus operate without requiring fresh supply of liquid solution for a long period, thereby facilitating the maintenance of the plant growing cabinet.
- [0014] In an embodiment of the invention, the plant growing cabinet comprises a liquid chamber positioned in the body. By this, a compact structure is

provided for the dwellings with limited space, thereby improving product perception.

[0015] The advantage of the invention is improving the yield of the plants to be cultivated by enabling the plants growing in the plant growing tray, to receive liquid solution in the amount they require for growing by preventing liquid leakage in plant growing cabinets.

[0016] A plant growing cabinet realized to achieve the aims of the present invention is illustrated in the accompanying drawings, wherein:

[0017] Figure 1 is a frontal view of the plant growing cabinet.

[0018] Figure 2 is a view of the plant growing cabinet from behind.

[0019] The elements in the figures are numbered individually and the correspondence of these numbers are given hereinafter.

[0020] 1. Plant growing cabinet

[0021] 2. Plant growing unit

[0022] 3. Body

[0023] 4. Plant growing tray

[0024] 5. Liquid chamber

[0025] 6. Sensor

[0026] 7. Transmission tube

[0027] 8. Transmission valve

[0028] 9. Discharge tube

[0029] 10. Discharge valve

[0030] 11. Control unit

[0031] 12. Signaling means

[0032] 131. Transmission line volumetric flow meter

[0033] 132. Discharge line volumetric flow meter

[0034] The plant growing cabinet (1) of the invention comprises a body (3) in which at least one plant growing unit (2) is disposed, a plant growing tray (4) with a base of perforated structure, in which the mixture enabling the plants to grow is put, and placed on the plant growing unit (2) so as to form a first volume (V1) in between itself and the base of the plant growing unit (2), a liquid chamber (5) in liquid connection with the plant growing unit (2), in which the liquid solution required by the plants to grow is stored, a

sensor (6) measuring the level of the liquid in the liquid chamber (5), a transmission tube (7) enabling fluid connection between the liquid chamber (5) and the plant growing unit (2) and a transmission valve (8) enabling the liquid to be transmitted to the plant growing unit (2), a discharge tube (9) discharging to the liquid chamber (5) the excess liquid remaining in the plant growing unit (2) after being absorbed by the mixture, and a discharge valve (10) connecting the discharge tube (9) to the plant growing unit (2).

[0035] The plant growing cabinet (1) of the invention comprises a control unit (11) enabling the plants in the plant growing tray (4) to be watered by transmitting liquid of an amount of the second volume (V2) greater than the first volume (V1) to the plant growing unit (2), and transmitting to and discharging from the plant growing unit (2) the liquid in an amount of the third volume (V3) less than the first volume (V1), and detecting a liquid leakage by comparing the liquid levels before transmission and after discharge obtained from the sensor (6).

[0036] Plant growing units (2) are placed into the plant growing cabinet (1) so as to be positioned within the body (3). The number and the dimensions of the plant growing units (2) can be varied according to the dimensions of the body (3) and the needs of a user. The plant growing unit (2) has a rectangular or square shape, and the liquid solution pumped by the liquid pump is collected on its base. A plant growing tray (4) is placed onto the plant growing unit (2). By this, the volume between the plant growing unit (2) and the plant growing tray (4) forms a first volume (V1). A liquid chamber (5) is positioned in the plant growing cabinet (1). The liquid in the liquid chamber (5) is transmitted to the plant growing unit (2) by means of a pump when the humidity of the turf or a similar mixture contained in the plant growing tray (4), enabling the plant to take root and grow, decreases below a level predetermined by the producer. In cases when the pumped liquid is more than the first volume (V1), this excess liquid humidifies the mixture contained in the plant growing tray (4) through the base of perforated structure, enabling the plants to grow. The remaining liquid is then discharged from the plant growing unit (2) and is transmitted to the

liquid chamber (5). The level difference of the liquid before and after transmission is compared by means of the sensor (6) provided in the liquid chamber (5), and the amount of liquid used by the plants can thus be measured. Transmission is performed through the transmission tube (7). A sealing connection is provided by means of the transmission valve (8) located at the point where the transmission tube (7) joins the plant growing unit (2). Likewise, the excess liquid remaining in the plant growing unit (2) after watering is discharged to the liquid chamber (5) by means of the discharge tube (9). A sealing connection is provided by means of the discharge valve (10) located at the point where the discharge tube (9) joins the plant growing unit (2). The second volume (V_2) which is the volume of the liquid pumped during watering of the plants, is greater than the first volume (V_1), and liquid can thus be introduced into the plant growing tray (4). In addition to watering of the plants, thanks to its control unit (11) the plant growing cabinet (1) has a second operation process enabling liquid in the amount of a third volume (V_3) which is less than the first volume (V_1), to be pumped into the plant growing unit (2). The control unit (11) pumps liquid of a third volume (V_3) into the plant growing unit (2) by means of the pump provided in the liquid chamber (5). This liquid cannot reach the base of the plant growing tray (4) and therefore cannot be absorbed by the mixture, and is discharged to the liquid chamber (5) through the discharge tube (9). The sensor (6) measures the liquid level in the liquid chamber (5) before and after this process, and transmits this value to the control unit (11). In cases when a difference occurs between two values, the control unit (11) determines the presence of a liquid leakage in the plant growing cabinet (1). By this, the liquid in the liquid chamber (5) is prevented from physically damaging the living environment of the user due to leakage, enabling the plants to receive the liquid they require while avoiding liquid waste.

[0037] In an embodiment of the invention, the plant growing cabinet (1) comprises a control unit transmitting to and discharging from a plurality of plant growing units (2) liquid in an amount of the third volume (V_3) by means of the transmission tube (7) and the discharge tube (9) respectively, and

detecting liquid leakage by comparing the levels of the liquid in the liquid chamber (5) before transmission and after discharge. By this, liquid leakages likely to occur in a plurality of plant growing units (2) can be detected by means of a single control unit (11), thereby enhancing customer satisfaction by improving costs.

[0038] In an embodiment of the invention, the plant growing cabinet (1) comprises a signaling means (12) alerting the user visually or audibly when the control unit (11) detects liquid leakage. By this, the user is informed about liquid leakage in the quickest manner, thereby minimizing damages, and enhancing the quality perception of the product.

[0039] In another embodiment of the invention, the plant growing cabinet (1) comprises a wireless signaling means (12) capable of communicating the liquid leakage information obtained from the control unit (11) to the user via the user's mobile communication devices providing wireless access. By this, the user is enabled to be informed about liquid leakage also in cases when he/she does not have direct access to the plant growing cabinet (1), thereby improving product perception by providing ease and flexibility of use.

[0040] In an embodiment of the invention, the plant growing cabinet (1) comprises a transmission line volumetric flow meter (131) provided at the outlet of the transmission valve (8), measuring the volume of the liquid passing therethrough and transmitting the results to the control unit (11). The control unit (11) compares the liquid level obtained from the sensor (6) with the liquid volume received from the transmission line volumetric flow meter (131), and the control unit (11) can thus detect whether liquid leakage is present on the transmission tube (7) and the transmission valve (8).

[0041] In an embodiment of the invention, the plant growing cabinet (1) comprises a discharge line volumetric flow meter (132) provided at the inlet of the discharge valve (10), measuring the volume of the liquid passing therethrough and transmitting the results to the control unit (11). The control unit (11) compares the liquid volume obtained from the transmission line volumetric flow meter (131) with the liquid volume

obtained from the discharge line volumetric flow meter (132), and the control unit (11) can thus detect whether liquid leakage is present in the plant growing unit (2). The liquid cycle of the plant growing cabinet (1) is segmented into three separate portions as the transmission line, the plant growing unit (2) and the discharge line by means of using the transmission line volumetric flow meter (131) and the discharge line volumetric flow meter (132), and the user is given precise information about the location of the liquid leakage, thereby improving product perception while facilitating maintenance of the plant growing cabinet (1).

- [0042] In an embodiment of the invention, the plant growing cabinet (1) comprises a control unit (11) of a structure suitable for starting watering and liquid leakage detection operations in time periods differing from each other. By this, using more than one control unit (11) is not required, thereby improving product costs.
- [0043] In an embodiment of the invention, the plant growing cabinet (1) comprises a liquid chamber (5) positioned out of the body (3). The internal volume of the plant growing cabinet (1) can be utilized thanks to the liquid chamber (5) being suitable for positioning out of the body (3), thus increasing the yield obtained from the plant growing cabinet (1), improving the product perception of the user.
- [0044] In an embodiment of the invention, the plant growing cabinet (1) comprises a liquid chamber (5) positioned in the body (3). The plant growing cabinet (1) constitutes a compact structure thanks to the liquid chamber (5) being suitable for positioning in the body (3). By this, the user does not require an extra space out of the plant growing cabinet (1), saving space.
- [0045] By means of the invention, seep and leakage events occurring due to physical damage on liquid transmission and discharge lines and the plant growing tray (4) in plant growing cabinets (1), are enabled to be detected, and it is thus envisaged to prevent damages likely to happen due to liquid leakage from a plant growing cabinet (1).

Claims

1. A plant growing cabinet (1) **comprising** a body (3) in which at least one plant growing unit (2) is disposed, a plant growing tray (4) with a base of perforated structure, in which the mixture enabling the plants to grow is put, and placed on the plant growing unit (2) so as to form a first volume (V1) in between itself and the base of the plant growing unit (2), a liquid chamber (5) in liquid connection with the plant growing unit (2), in which the liquid solution required by the plants to grow is stored, a sensor (6) measuring the level of the liquid in the liquid chamber (5), a transmission tube (7) enabling fluid connection between the liquid chamber (5) and the plant growing unit (2) and a transmission valve (8) enabling the liquid to be transmitted to the plant growing unit (2), a discharge tube (9) discharging to the liquid chamber (5) the excess liquid remaining in the plant growing unit (2) after being absorbed by the mixture, and a discharge valve (10) connecting the discharge tube (9) to the plant growing unit (2), **characterized by** a control unit (11) enabling the plants in the plant growing tray (4) to be watered by transmitting liquid of an amount of the second volume (V2) greater than the first volume (V1) to the plant growing unit (2), and transmitting to and discharging from the plant growing unit (2) liquid in an amount of the third volume (V3) less than the first volume (V1), and detecting a liquid leakage by comparing the liquid levels before transmission and after discharge obtained from the sensor (6).
2. A plant growing cabinet (1) according to claim 1, **characterized by** a control unit (11) transmitting to and discharging from a plurality of plant growing units (2) liquid in an amount of the third volume (V3) by means of the transmission tube (7) and the discharge tube (9) respectively, and detecting liquid leakage by comparing the levels of the liquid in the liquid chamber (5) before transmission and after discharge.
3. A plant growing cabinet (1) according to any one of the preceding claims, **characterized by** a signaling means (12) alerting the user visually or audibly when the control unit (11) detects liquid leakage.
4. A plant growing cabinet (1) according to any one of the preceding claims, **characterized by** a transmission line volumetric flow meter (131) provided at the outlet of the transmission valve (8), measuring the volume of the liquid

- passing therethrough and transmitting the results to the control unit (11).
5. A plant growing cabinet (1) according to any one of the preceding claims, **characterized by** a discharge line volumetric flow meter (132) provided on the discharge valve (10), measuring the volume of the liquid passing therethrough and transmitting the results to the control unit (11).
 6. A plant growing cabinet (1) according to any one of the preceding claims, **characterized by** a control unit (11) of a structure suitable for starting watering and liquid leakage detection operations in time periods differing from each other.
 7. A plant growing cabinet (1) according to any one of the preceding claims, **characterized by** the liquid chamber (5) positioned out of the body (3).
 8. A plant growing cabinet (1) according to any one of the claims 1 to 6, **characterized by** the liquid chamber (5) positioned in the body (3).

Figure 1

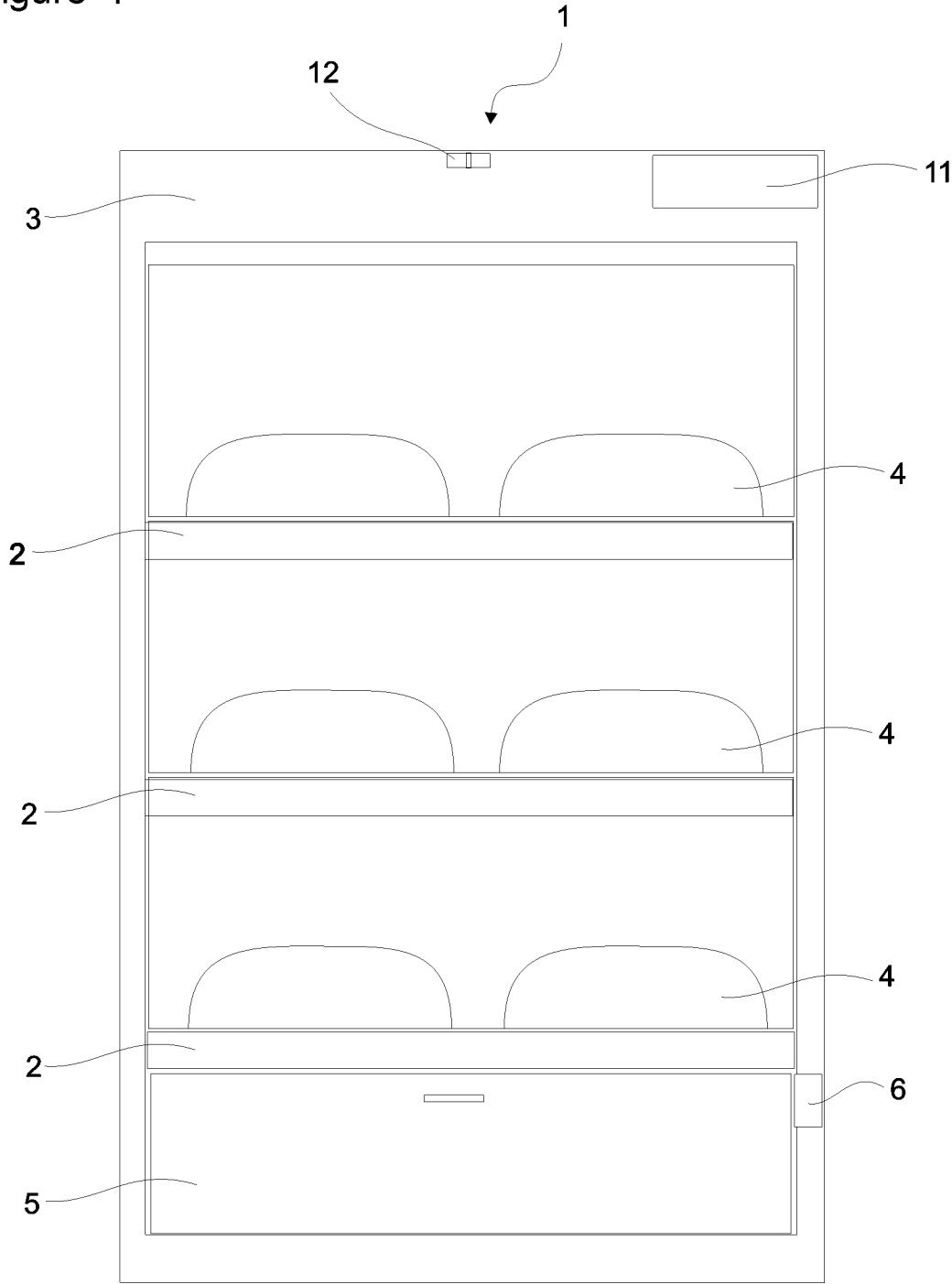
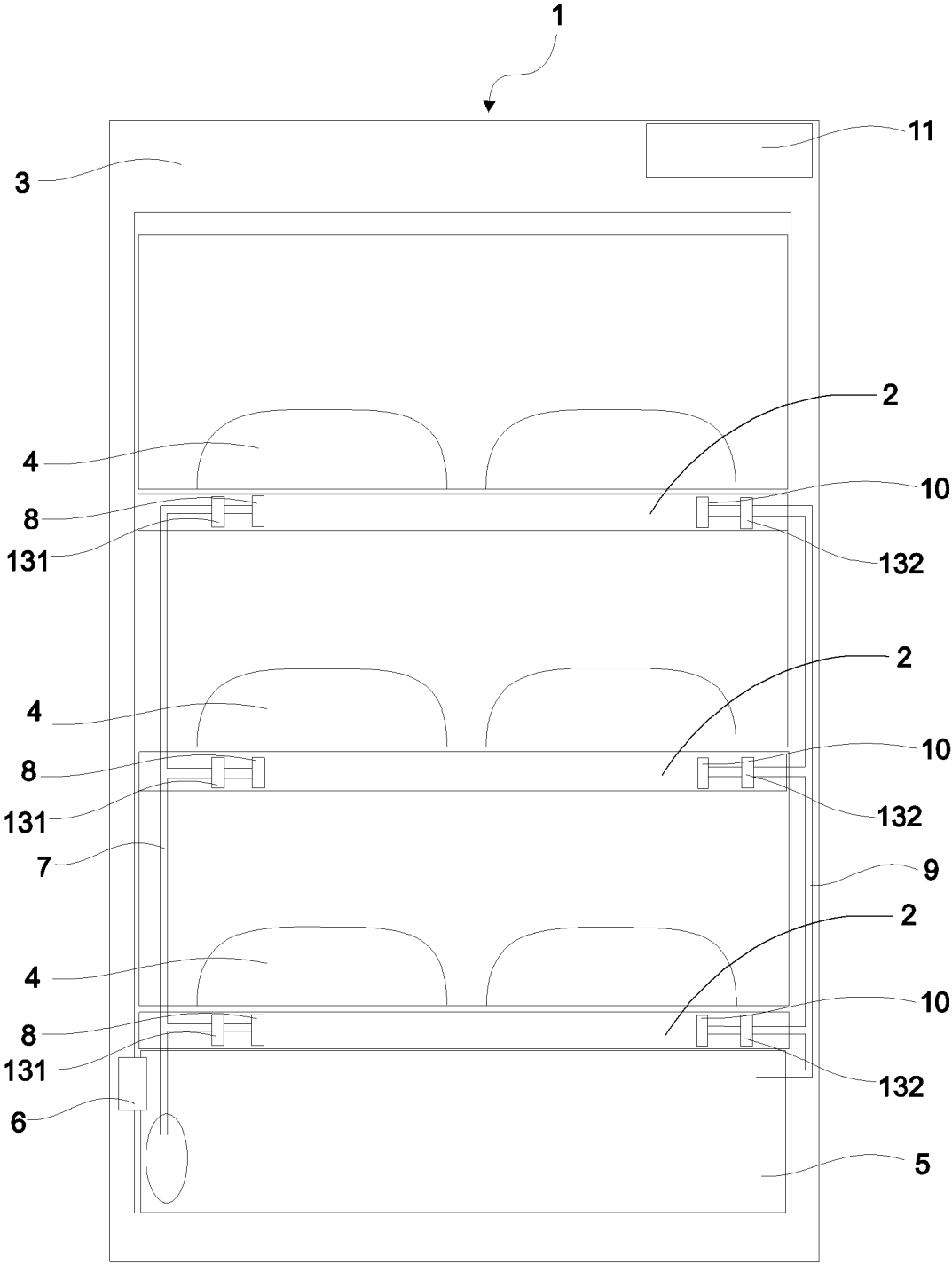


Figure 2



INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER
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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)
A01G

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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.
A	CN 205 018 017 U (BAI HAIYAN) 10 February 2016 (2016-02-10) paragraphs [0053], [0059] - paragraph [0061]; figures 1-6 -----	1-8
A	WO 2016/164652 A1 (GROWX INC [US]) 13 October 2016 (2016-10-13) paragraph [0114]; figure 1A -----	1-8
A	KR 2013 0017139 A (C & W UNITED CO LTD [KR]; KIM SSANG MOK [KR]; KIM GEUN HYO [KR]; SPGRE) 20 February 2013 (2013-02-20) paragraph [0023] - paragraph [0039]; figures 1-8 -----	1-8
A	CN 205 408 804 U (ZHOU DONGXIANG) 3 August 2016 (2016-08-03) paragraph [0059] - paragraph [0069]; figures 1-10 -----	1-8



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INTERNATIONAL SEARCH REPORT

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Patent document cited in search report		Publication date	Patent family member(s)	Publication date
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