

A PLANT HOUSING DEVICE

FIELD OF INVENTION

The invention relates to a plant housing device suitable for landscaping, and in particular, to a plant housing device suitable for use in vertical landscaping.

5 BACKGROUND TO THE INVENTION

The following discussion of the background to the invention is intended to facilitate an understanding of the present invention. However, it should be appreciated that the discussion is not an acknowledgment or admission that any of the material referred to was published, known or part of the common general
10 knowledge in any jurisdiction as at the priority date of the application.

Urban heat island effect (UHIE) refers to the phenomenon when city temperatures run higher than those in suburban and rural areas. UHIE occurs primarily due to the growing numbers of buildings being built as a consequence of urbanization and economic growth, and these growing numbers of buildings have
15 supplanted vegetation and trees previously filling the city area. In addition, human activities generate heat and such generation of heat contributes to the rise in city temperatures.

In an attempt to reduce the adverse influence of the UHIE, vegetation is grown on rooftops (i.e. green roof), and more recently on building facades (i.e. green
20 wall), to compensate for the loss of supplanted vegetation and trees. The vegetation serves to filter greenhouse gases such as carbon dioxide and other toxins in the city. It has been studied and demonstrated that such vegetation helps to reduce the building ambient temperature, resulting in lesser dependence on electrical appliances such as fans, air-conditioning units, etc, thereby lessening the
25 building's energy consumption.

In a conventional green wall system, plant substrates (including the soil, pebbles etc whereby the roots of the plants may anchor onto) are conveniently contained in big geotextile bags. Each geotextile bag is packed into a modular plant housing device having a rectangular or square box shape. The modular plant
30 housing

devices are then assembled and stacked up in a vertical manner to form a vertical wall. Plant root balls are planted in the plant substrates and when plant growth has established, the vertical wall is said to be covered with vegetation, thereby forming a green wall.

5 As time passes, settling and disintegrating of plant substrates due to containment within a big geotextile bag becomes apparent since the modular plant housing devices are assembled vertically. When settling of the plant substrates occur, the root balls of the plants may lose grip on the plant substrates. This affects the optimal growth of the plants, especially those positioned at higher level
10 in the plant housing devices. Topping up of the plant substrates may be needed and this adds to the weight of the entire assembly. This in turn may pose as a hazard particularly when the assembly is to be mounted onto a building facade.

Further, during irrigation water flows from top plant housing devices to bottom plant housing devices. Excess water may carry leached fertilizers and may
15 accumulate in the bottom plant housing devices. Such accumulation of fertilizers in the plant substrates leads to problems such as salt burn effects in the plants, thereby affecting the optimal growth of the plants.

In the event that certain sections of the plant housing device require replacement, for instance, when the plants affected by the salt burn effects (which
20 are usually located nearer the bottom of the plant housing device) need to be replaced, the entire geotextile bag will have to be removed from the assembly and plant substrates repacked.

Therefore, it is desirable to provide plant housing device that overcomes, or at least alleviates, the above problems.

25 **SUMMARY OF THE INVENTION**

Throughout this document, unless otherwise indicated to the contrary, the terms "comprising", "consisting of", and the like, are to be construed as non-exhaustive, or in other words, as meaning "including, but not limited to".

In a first aspect of the present invention, there is provided a plant housing
30 device for use in landscaping, comprising:

- a substrate container having a plurality of compartments for containing a plurality of plant substrates, wherein the substrate container is formed of a substantially grid configuration thereby forming the plurality of compartments; and
- 5 – a casing defining a hollow body therein to house the substrate container, the casing having a plurality of openings corresponding to the plurality of compartments for access to the plurality of plant substrates.

BRIEF DESCRIPTION OF THE DRAWINGS

10 In the figures, which illustrate, by way of example only, embodiments of the present invention,

FIG. 1 shows a perspective view of the components of the plant housing device in a first aspect.

FIG. 2 shows a perspective view of the assembled plant housing device of **FIG. 1**.

15 **FIG. 3a** shows a close-up perspective view of the irrigation means integrated with the plant housing device of **FIG. 1**.

FIG. 3b shows a close-up perspective view of the snap-on configuration of the plant housing device of **FIG. 1** in one embodiment.

20 **FIG. 3c** shows a perspective view of the horizontal grid members and the vertical grid members having protrusions and perforations in another embodiment.

FIG. 4 shows a close-up perspective view of the drainage means integrated with the plant housing device of **FIG. 1**.

FIG. 5a shows a schematic diagram on the irrigation system and drainage system in an assembly of modular plant housing devices of **FIG. 1**.

25 **FIG. 5b** shows an assembly of modular plant housing devices of **FIG. 1** for use in vertical landscaping.

FIG. 6a shows a close-up view of the assembly of modular plant housing device of **FIG. 5b**.

FIG. 6b shows an embodiment of the top connector for use in the assembly of **FIG. 5b**.

5 **FIG. 6c** shows an embodiment of the intermediate connector for use in the assembly of **FIG. 5b**.

DETAILED DESCRIPTION

The invention relates to a plant housing device suitable for landscaping, and in particular, to a plant housing device suitable for use in vertical landscaping.

10 A first embodiment of the invention is illustrated in **FIG. 1**, showing an exploded view of the plant housing device **1**, and **FIG. 2**, showing an assembled plant housing device **1**. The plant housing device **1** comprises a substrate container **2** having a plurality of compartments **3** for containing a plurality of plant substrates (not shown) and a casing **6** (alternatively, **6a** and **6b**) defining a hollow body
15 therein to house the substrate container **2**. Each plant substrate is contained in individual geotextile bag, and therefore the plurality of plant substrates are contained in a plurality of geotextile bags.

In the embodiment as illustrated, the substrate container **2** comprises three horizontal grid members **4** and three vertical grid members **5** to form a grid
20 configuration, thereby forming a total of sixteen compartments **3**. Although a sixteen-compartment substrate container **2** has been described herein, it is understood and appreciated that the number of horizontal grid members **4** and the number of vertical grid members **5** may be varied in order to obtain the desired number of compartments. Further, the size of each compartment **3** may be
25 adjusted by varying the distance between each horizontal grid member **4** and each vertical grid member **5**. For example, if different species of plants are intended to be placed in the same plant housing device, and if some of these plant substrates require more space than the others in order to develop optimal plant growth, then differently sized compartments **3** in the substrate container **2** may be designed and
30 catered for.

The casing **6** is shown to comprise a back cover **6a** and a front cover **6b**. The back cover **6a** is shown to comprise two opposing side walls connected by a back wall, thereby forming an "U" shape when viewed from the plan view. In this illustration, the front cover **6b** is the side of the casing **6** which provides access to the plant substrates. The front cover **6b** contains openings **7** corresponding to the compartments **3**, through which the plant substrates may be assessed. The casing **6** is formed and defines a hollow body within the casing **6** when the back cover **6a** and front cover **6b** are joined together in a closed manner. The hollow body houses the substrate container **2** within the hollow body. Within the hollow body defined by the interior of the casing **6**, horizontal support members **8** and vertical support members **9** are provided on the interior of the back cover **6a** to hold in place the horizontal grid members **4** and the vertical grid members **5**, respectively. The horizontal support members **8** are angled and positioned to hold the substrate container **2** such that the substrate container **2** sits snugly and the substrates in the geotextile bags sit snugly by gravity within the hollow body when the casing **6** is closed. In this manner, the plant substrates, when housed in the substrate container **2**, are secured and will not fall out of position. To further secure the geotextile bags in place, the horizontal grid members **4** and vertical grid members **5** are preferably each provided with protrusions **40**, **42** to enhance the grip on the geotextile bags. The horizontal grid members **4** and the vertical grid members **5** are preferably each perforated to allow the growth of the root balls of the plant substrates and penetration of water via the perforations **44**, **46**. The horizontal grid members **4** and the vertical grid members **5** having protrusions **40**, **42** and perforations **44**, **46** are shown in **FIG. 3c**. To further secure the geotextile bags in place, the front cover **6b** may comprise front plates that may be slidably inserted into the front cover **6b**. It is illustrated in this embodiment that the back cover **6a** is wider than the front cover **6b** in order to accommodate the horizontal support members **8** and vertical support members **9**. It may be the case where the horizontal support members **8** and vertical support members **9** are located on the interior of the front cover **6b** instead. Besides providing openings **7** on the front cover **6b**, further openings **7** may also be provided on the back cover **6a** such that the plant housing device **1** is symmetrical on both the front end and back end, i.e.

access to the plant substrates is available through both the front end and the back end. This arrangement is useful as a partition wall.

The plant housing device **1** further comprises an irrigation means **10** located at the top of the plant housing device **1**, as shown in **FIGS. 1, 2, 3a** and **3b**. The top
5 of the plant housing device **1** is profiled to accommodate the irrigation means **10**.

Preferably, the profile **11** is substantially configured to suit the configuration of the irrigation means **10** such that the irrigation means **10** sits securely in the profile **11**. A close-up view of the profile for accommodating the irrigation means **10** is shown in **FIG. 3a** and **3b**, whereby a U-shaped channel is provided to receive the

5 irrigation means **10** having a cylindrical pipe configuration. The irrigation means of adjacent modular plant housing devices may be connected together and may further be connected to a central irrigation pipe, which will be described later.

Besides providing the possibility of having an integrated irrigation system within the plant housing device **1**, the design of the plant housing device **1** also allows

10 easy access to the irrigation means **10** for maintenance or replacement purposes.

The back cover **6a** and the front cover **6b** are connected and locked in place by means of a snap-on configuration as illustrated in **FIG. 3b**. A protrusion **16a** is provided on a side wall of the back cover **6a**. A recess **16b** is provided on a side wall of the front cover **6b**. The protrusion **16a** and the recess **16b** are configured in
15 such a way that their shapes and their locations correspond to each other, and the protrusion **16a** fits tightly in the recess **16b** when the casing **6** is closed. Besides being able to provide a tight fit, preferably the protrusion **16a** and the recess **16b** are being able to be pulled apart with sufficient force so that the front cover **6b** may be opened to provide access to the plant substrates for maintenance
20 purposes. Other interlocking configurations are also possible. For example, the casing **6** may be held closed by means of screw and nut or spring lock and socket or ledges or snap-lock joints such as studs. Advantageously the casing **6** is formed of lightweight and resilient materials such as polypropylene and high density polyethylene (HDPE) so that the modular plant housing device **1** is easily installed
25 with minimal manpower. Recesses **34** are also provided on an edge wall of the back cover **6a** and/or front cover **6b**. The edge wall recess **34** receives a flange **28** of an intermediate connector **18**, which will be described later. Edge wall recess at the bottom may also receive a flange **28** of an intermediate connector **18**.

The plant housing device **1** further comprises a drainage means **12** located at
30 the bottom of the plant housing device **1**, as shown in **FIGS. 1, 2** and **4**. The bottom of the plant housing device **1** is profiled so that excess fluid (e.g. water and fertilizer) is not retained in the plant housing device **1**, but instead the excess fluid is being drained away via the drainage means **12**. Conveniently, the profile **13** is

substantially configured to form a U-shaped channel to receive the drainage means **12** having a cylindrical pipe configuration. The drainage means of adjacent modular plant housing devices may be connected together and may further be connected to a central drainage down pipe, which will be described later.

5 Alternatively, the profile **13** may be at the bottom of the plant housing device **1** as an orifice located conveniently at the centre of the bottom so that excess water is drained off by gravity in a vertical manner via drainage means such as a drainage pipe. It is to be understood that the orifice may be located off-centre or towards one end of the bottom. Besides providing the possibility of having an integrated
10 drainage system within the plant housing device **1**, the design of the plant housing device **1** also prevents accidental spill of excess fluid from a plant housing device positioned at a higher level to a plant housing device positioned at a lower level. Optionally, a pest netting **14** may be provided near the bottom of the plant housing device **1** but above or sitting on the profile **13** for the drainage mean **12**, as shown
15 in **FIG. 2**. The pest netting **14** prevents pests such as mosquitoes and toads from entering and propagating in the drainage system. Further, the pest netting **14** also prevents clogging of the drainage system due to particles or leaves falling from above.

FIG. 5a illustrates schematically the irrigation system and drainage system in an
20 assembly of modular plant housing devices **1**. In the matrix configuration as shown, the irrigation means **10** of adjacent plant housing devices **1** in each row are connected to one another. A first end of the irrigation means **10** of the plant housing device **1** at a corner of the top row is connected to a pressure-regulated water supply. A second end of the irrigation means **10** of the plant housing device
25 **1** at another corner of the top row farthest from the first end is connected to a third end of the irrigation means **10** of the plant housing device **1** at a corner of a lower row. During operation, water enters at the first end and flows through each plant housing device **1** in the top row sequentially. When it reaches the second end, water flows down to the lower row and continues to flow through each plant
30 housing device **1** in the lower row. The flow of water continues in a similar snaking pattern until it reaches the bottom row where each plant housing device **1** in the assembly has been watered. In this illustration, water in the irrigation means **10** flows by gravity means and in one directional without requiring pumps. Excess

water then exits the irrigation system and joins the drainage system via a drainage outlet pipe. Similarly, the drainage means **12** of adjacent plant housing devices **1** are connected to one another in each row. Unlike the irrigation system which forms a snaking pattern so that water flows through each plant housing device **1** in the assembly, the drainage means **12** connected in each row are connected via

the drainage outlet pipe at one side of the assembly. Excess water after irrigation is collected and drained by the drainage means **12** in each row, and eventually drained out of the assembly by the drainage outlet pipe. The assembly of the plant housing devices **1** each having integrated irrigation system and drainage system provided in this manner has the advantage of avoiding or alleviating the problems caused by salt burn faced in prior art devices since (i) only fresh water is irrigated to each plant housing device **1**, and (ii) fertilizers leached in each plant housing device **1** are drained away immediately without contaminating other plant housing devices **1**.

In **FIG. 5b**, an assembly **15** of a plurality of modular plant housing devices **1** is shown for vertical landscaping, for example, for mounting onto the facade of a building to provide greenery. Each individual modular plant housing device **1** is attached to two vertical railings **17** by means of top connectors **20**, bottom connectors **19**, and/or intermediate connectors **18**. The plant housing device **1** is installed such that the back cover **6a** is attached to the vertical railings **17** while the openings **7** on the front cover **6b** faces away from the vertical railings **17**. The top connector **20** (the mirror image being the bottom connector **19**) and intermediate connector **18** are illustrated in **FIG. 6b** and **FIG. 6c**, respectively. The intermediate connector **18** is shown to have a substantially C-shape configuration formed of a top wall **26** and a bottom wall **24** joined by a side wall **22**. At the opposing end of the side wall **22** where the top wall **26** and the bottom wall **24** are free-standing, an upward-extending flange **30** extends from the top wall **26** while a downward-extending flange **28** extends from the bottom wall **24**. A securing means **32** is provided on the side wall **22** for securing to the vertical railings **17** when installed. The top connector **20** has a similar configuration as the intermediate connector **18**, except that it does not have a top wall **26** and an upward-extending flange **30**. **FIG. 6a** shows the intermediate connectors **18** when it is in use. The downward-extending flange **28** extends from the bottom wall **24** of the intermediate connector **18** and is received in the recess **34** provided on the edge wall of the back cover **6a** and front cover **6b**. Other alternative attaching means for the plant housing devices **1** are also possible, for example, hooks provided on the back cover **6a** are slotted into recesses provided on the vertical railings **17**.

The afore-described plant housing device provides several advantages outlined as follows: -

- 5 (a) When the plant substrates are each contained in individual geotextile bags, the problem of settling and disintegrating of substrates due to their containment in a single big geotextile bag is avoided. In addition, in the event when replacement of plant substrates is needed, the compartmentalized substrate container design allows ease for doing so since the plant substrates are now contained in individual geotextile bags.
- 10 (b) The number of compartments formed in the substrate container is adjustable to suit the desired outlook of the device. In addition, the size of each compartment is also adjustable to achieve different effects.
- (c) The integrated irrigation system and the profile for receiving the irrigation means provided at the top of the plant housing device allows easy reach to the irrigation means for maintenance purposes.
- 15 (d) The integrated drainage system overcomes the problems associated with salt burn since excess water and fertilizers are drained away via the drainage outlet pipe without contaminating other plant housing devices.
- (e) The front cover is designed for easy opening for easy maintenance.
- 20 (f) The plant housing device is made of lightweight material so that minimal manpower is needed for installation and maintenance.

Although the foregoing invention has been described in some detail by way of illustration and example, and with regard to one or more embodiments, for the purposes of clarity of understanding, it is readily apparent to those of ordinary skill in the art in light of the teachings of this invention that certain changes, variations and modifications may be made thereto without departing from the spirit or scope of the invention as described in the appended claims.

I CLAIM:

1. A plant housing device for use in landscaping, comprising:
 - a substrate container having a plurality of compartments for containing a plurality of plant substrates each contained in individual bag, wherein the substrate container is formed of a substantially grid configuration thereby forming the plurality of compartments;
 - a casing defining a hollow body therein to house the substrate container, the casing having a plurality of openings corresponding to the plurality of compartments for access to the plurality of plant substrates; and
 - a drainage means located at the bottom of the casing.
2. The plant housing device of claim 1, wherein the substrate container comprises at least one horizontal grid member and at least one vertical grid member assembled to thereby form the grid configuration.
3. The plant housing device of claim 1 or 2, wherein the casing comprises a front cover and a back cover, and the casing defines the hollow body therein when the front cover and the back cover are joined together by an interlocking means.
4. The plant housing device of claim 3, wherein the interlocking means enables the front cover to be removed, thereby providing access to the plurality of plant substrates.
5. The plant housing device of claim 3 or 4, wherein the interlocking means is one of studs, screws and nuts, spring locks and sockets, ledges, or snap-lock joints.
6. The plant housing of any one of claim 3 to 5, wherein the plurality of openings in the casing are formed on the front cover.
7. The plant housing of any one of claims 3 to 6, wherein the interior of the back cover comprises at least one horizontal support member and at least one vertical support member to hold the respective horizontal grid member and vertical member.

8. The plant housing device of any one of claims 3 to 7, wherein the horizontal grid member and vertical grid member each comprise protrusions and perforations.
9. The plant housing device of any one of claims 3 to 8, wherein the front cover further comprises a removable front plate covering a portion of the plurality of openings in the casing.
10. The plant housing device of any one of the preceding claims, further comprising an irrigation means located at the top of the casing.
11. The plant housing device of any one of the preceding claims, wherein the bottom of the casing is profiled to provide for the drainage means.
12. The plant housing device of claim 11, wherein the bottom of the casing further comprises an orifice and the bottom of the casing is profiled to slope towards the orifice.
13. An assembly of a plurality of plant housing device of any one of the preceding claims, wherein the irrigation means of a first plant housing device is connected to the irrigations means of an adjacent plant housing device.
14. The assembly of claim 13, wherein the drainage means of a first plant housing device is connected to the drainage means of an adjacent plant housing device.