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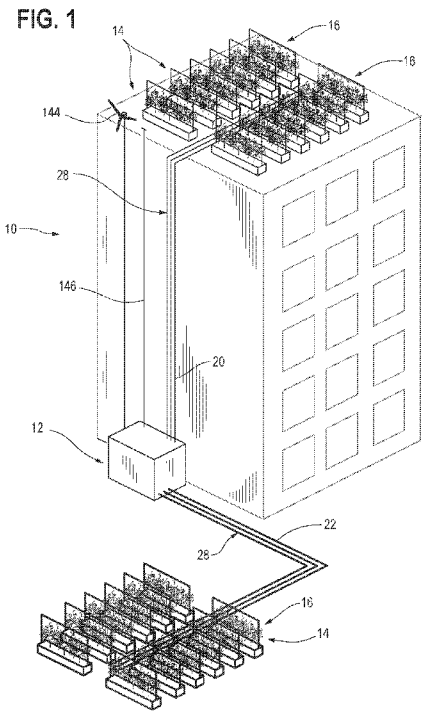
(54) Title: SYSTEM FOR SUPPORTING PLANT LIFE



(57) Abstract: A system for providing nutrients to a plant may support the plant with the root system exposed and accessible in a controlled environment within a structure, effecting interaction between a carrier fluid and a soil-based medium to transport nutrients from the soil-based medium to targeted plants. The soil-based medium may comprise organic soil at or near grade level and/or other media at other elevations. In some embodiments, the system includes a structure that comprises a roof-mounted frame placed in a location that can expose portions of plants to natural sunlight and a lightweight, aerated, humiditycontrolled enclosure around the root system.

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INTERNATIONAL SEARCH REPORT

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A. CLASSIFICATION OF SUBJECT MATTER

IPC - INV. C12N 1/14, C12N 1/16, C05G 3/00 (2024.01)
ADD. C12N 1/00 (2024.01)

CPC - INV. C12N 1/14, C12N 1/16, C05G 3/00
ADD. C12N 1/00

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)
See Search History document

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y --- A	US 2018/0343812 A1 (Leo) 6 December 2018 (06.06.2018) Entire document, especially Abstract, para [0097]; [0229]; [0231]; [0235]; [0242]; [0262]-[0264]; [0267]; [0270]; [0290]; [0292]; [0303]; [0305]; [0311]; [0336]; [0632]; [0637]; [0665]; [0776]; [0992]; [1182]	1-4, 18-19 --- 5-17
Y --- A	US 2023/0173126 A1 (Radical Clean Solutions Ltd.) 8 June 2023 (08.06.2023) Entire document, especially Abstract, para [0057]-[0058]	1-4, 18-19 --- 5-17
A	WO 2022/177972 A1 (Revol Greens GBC) 25 August 2022 (25.08.2022) Entire document	1-19
A	WO 2022/187364 A1 (Neox Public Benefit LLC) 9 September 2022 (09.09.2022) Entire document	1-19
A	US 2014/0069008 A1 (Herrera-Estrella et al.) 13 March 2014 (13.03.2014) Entire document	1-19
A	US 10,499,645 B2 (Monsanto Technology LLC) 10 December 2019 (10.12.2019) Entire document	1-19

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"D" document cited by the applicant in the international application
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
3 September 2024	DEC 10 2024
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-8300	Authorized officer Kari Rodriquez Telephone No. PCT Helpdesk: 571-272-4300

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US 24/34143

Box No. II Observations where certain claims were found unsearchable (Continuation of item 2 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box No. III Observations where unity of invention is lacking (Continuation of item 3 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:
-- see extra sheet --

1. ☐ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.

2. ☐ As all searchable claims could be searched without effort justifying additional fees, this Authority did not invite payment of additional fees.

3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:

4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:
1-19

Remark on Protest

☐ The additional search fees were accompanied by the applicant's protest and, where applicable, the payment of a protest fee.

☐ The additional search fees were accompanied by the applicant's protest but the applicable protest fee was not paid within the time limit specified in the invitation.

☐ No protest accompanied the payment of additional search fees.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/US 24/34143

Continuation of:
Box III Observations where unity of invention is lacking

This application contains the following inventions or groups of inventions which are not so linked as to form a single general inventive concept under PCT Rule 13.1. In order for all inventions to be searched, the appropriate additional search fees must be paid.

Group I: Claims 1-19 directed to a method of providing one or more nutrients to a plant that has a root system, the method comprising: a. providing a liquid and gas permeable soil-based medium comprising particulate organic matter, minerals, liquid, and organisms, b. providing a structure supporting the plant and maintaining an environment suitable for root growth such that within the structure the root system is exposed and accessible; and c. effecting intermittent flow of a carrier liquid through the soil-based medium to maintain gas permeability suitable for soil organisms to cause entrainment of a portion of the soil-based medium in the carrier liquid, then into contact with the root system in a manner that provides a film of carrier liquid on at least part of the root system and effects transfer of dissolved nutrients and particulate matter from the soil-based medium to the root system.

Group II: Claim 20 directed to a plant nutrient provision system comprising: a. a liquid and gas permeable soil-based medium; b. a structure supporting a plant that includes a root system, the structure having an interior and maintaining a controlled environment within the interior and enclosing the root system therein so that within the structure the root system is exposed and accessible, the soil-based medium being outside of the structure and separate therefrom; and c. a fluid flow system that effects flow of a carrier liquid through the son-based medium to cause entrainment of a portion of the soil-based medium in the carrier liquid, then into contact with the root system in a manner that provides a film of carrier liquid on at least part of the root system and effects transfer of dissolved nutrients and particulate matter from the soil-based medium to the root system; wherein the structure comprises a frame capable of being supported on a residential building in a location that can expose portions of the plant to natural sunlight.

The inventions listed as Groups I-II do not relate to a single general inventive concept under PCT Rule 13.1 because, under PCT Rule 13.2, they lack the same or corresponding special technical features for the following reasons:

Special Technical Features:

Group I requires a method of providing one or more nutrients to a plant that has a root system, the method comprising: a. providing a liquid and gas permeable soil-based medium comprising particulate organic matter, minerals, liquid, and organisms, not specifically required by Group II.

Group II requires a plant nutrient provision system comprising: a structure having an interior and maintaining a controlled environment within the interior, the soil-based medium being outside of the structure and separate therefrom; wherein the structure comprises a frame capable of being supported on a residential building in a location that can expose portions of the plant to natural sunlight, not specifically required by Group I.

Common Technical Features:

Groups I and II share the technical feature of a system comprising: a liquid and gas permeable soil-based medium; a structure supporting the plant and maintaining an environment suitable for root growth such that within the structure the root system is exposed and accessible; and a carrier liquid through the soil-based medium to maintain gas permeability suitable for soil organisms to cause entrainment of a portion of the soil-based medium in the carrier liquid, then into contact with the root system in a manner that provides a film of carrier liquid on at least part of the root system and effects transfer of dissolved nutrients and particulate matter from the soil-based medium to the root system.

However, these shared technical features do not represent a contribution over prior art, because the shared technical feature is obvious over US 2018/0343812 A1 to Leo in view of US 2023/0173126 A1 to Radical Clean Solutions Ltd. (hereinafter 'Radical'). Leo discloses a system (Abstract - '...Variable-scale, modular, easily manufacturable, energy efficient, reliable, and computer-operated farming superstructure systems (FSS) may be used to produce cannabis for human consumption with minimal water and environmental impact...') comprising: a liquid and gas permeable soil-based medium (para [0262] - '...FIG. 1B depicts one non-limiting embodiment of a farming superstructure system (FSS) that includes a first growing assembly (100) having a first growing medium (GM1) and a second growing assembly (200) having a second growing medium (GM2)...'; para [0263] - '...In embodiments, the first and second growing mediums (GM1, GM2) can be comprised of one or more from the group consisting of... coco-coir, fibrous coconut husks, soil, dirt, peat... soil...'); a structure supporting the plant and maintaining an environment suitable for root growth (Abstract - '...Variable-scale, modular, easily manufacturable, energy efficient, reliable, and computer-operated farming superstructure systems (FSS) may be used to produce cannabis for human consumption with minimal water and environmental impact...'; para [0267] - '...In embodiments, each growing assembly (100, 200) may include a container that contains a growing medium (GM1, GM2) sufficient to support the roots of the cannabis (107, 207). In embodiments, the growing assembly (100, 200) may be a container that contains a growing medium (GM1, GM2). FIG. 1C...'); and a carrier liquid through the soil-based medium (para [0229] - '...The roots of the cannabis in the lower section (106, 206) are healthier when contacted with an oxygenated liquid. Further, oxygenated and/or supersaturated water inhibits the growth of deleterious fungi on the fabric (104, 204)...'; para [0264] - '... Liquid from with pump (P1) is introduced into the interior (101, 201) of each growing assembly (100, 200) via a liquid input (114, 214) where the liquid contacts the growing medium (GM1, GM2)...'; para [0270] - '...In embodiments, liquid is transferred to the first growing assembly (100) and second growing assembly (200) on a periodic basic through the plurality of liquid supply conduits...'; see instant claim 2; Note: The carrier liquid is considered to comprise water), but does not further specifically disclose the supporting structure wherein within the structure the root system is exposed and accessible; or wherein the carrier liquid maintains gas permeability suitable for soil organisms to cause entrainment of a portion of the soil-based medium in the carrier liquid, then into contact with the root system in a manner that provides a film of carrier liquid on at least part of the root system and effects transfer of dissolved nutrients and particulate matter from the soil-based medium to the root system...

-- see extra sheet --

Continuation of:
Box III Observations where unity of invention is lacking

...Radical discloses a similar system (para [0057] - '...In the preferred agricultural hydroponic embodiment, as shown in FIGS. 6 and 6A, the hydroxyl generators can be used in greenhouses, for producing plants hydroponically, such as medicinal or other botanical plants, which are grown agriculturally inside a greenhouse...'), wherein air is provided directly to exposed and accessible roots while the roots are also being soaked in fluid (para [0058] - '...The pipe 360 has the lower parts of the roots and the media soaking in the fluid, with an upper portion of the roots and media being exposed to air of the plants 370, which have roots 370 a held in place by media 370B...'). It would have therefore been obvious to one of ordinary skill in the art to combine these references, and to modify the teachings of Leo with the disclosure of Radical, through routine experimentation because both references teach similar methods of growing plants, and because by leaving the roots exposed during growing, they are able to be misted, sprayed, and/or fertilized specifically without misting, spraying, or fertilizing any other part of the plant (see Radical, para [0058]-[0059]).

As the shared technical features were known in the art at the time of the invention, they cannot be considered common technical features that would otherwise unify the groups. Therefore, Groups I-II lack unity under PCT Rule 13.