Title: SINGLE SEEDLING NURSERY TRAY

(57) Abstract: The present invention provides a seedling nursery tray for transplanting propagates or plants into field, the seedling nursery tray (10) includes: a) a main tray (20) with plurality of seedling cavities or planting cells (22) disposed therein to enable seedlings grow independently in separated media, wherein the main tray (20) facilitates substantial root disturbance free environment that enables seedling's roots grow deep; and b) a sliding base (30) slidably introduced to the main tray (20), wherein the sliding base (30) facilitates to serve as a support and/or valley in holding and/or releasing seedlings from the main tray (20) to transplanter for planting into the field.
Declarations under Rule 4.17:
— as to applicant’s entitlement to apply for and be granted a patent (Rule 4.17(H))
— before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments (Rule 48.2(h))

Published:
— with international search report (Art. 21(3))
SINGLE SEEDLING NURSERY TRAY

FIELD OF INVENTION

5 The present invention relates generally to a seedling tray, and more particularly to a single seedling nursery tray for System of Rice Intensification (SRI) planting machine.

BACKGROUND OF INVENTION

10 It has been known that seedlings and for that matter any growing plant should be subjected to as little shock as possible throughout its growing cycle. One of the main causes of shock is the removal of a small growing plant or seedling prior to being transplanted into a larger growing receptacle for further growth prior to final transplanting or when transplanting to the ultimate growth area, such as in a field.

15 In many nursery operations, it is often necessary to distribute individual seeds into a planting area, such as a nursery flat, with the seeds properly spaced from one another so that each will have sufficient space to develop. The proper spacing of the seeds is particularly significant where multi-compartmented plug flats or multiple individual pots are seeded. To perform the task of seeding these nursery trays solely by hand is both time consuming and prone to error, for example, the placement of multiple seeds where a single seed should be located or the omission of a seed from its place. A variety of machines have been developed to automate the process of depositing seeds into their proper position in an array of a planting tray or flat. Such automated machines must be capable of separating individual seeds from a batch of seeds for further handling with minimal operator assistance, and the separated seeds must then be accurately
positioned individually at their proper positions in the array, again, preferably, with minimal operator assistance.

In rice production industry, seedling quality and transplanting skills, such as spacing and seedling number per hill, play a vital role in promoting optimum yield. Despite some researchers' agitation that the yield of rice can only be increased with increase in fertilizer application, the latter can be seen contrary with the advent of the System of Rice Intensification (SRI) techniques / innovations which changes the management of plants, soil, water and nutrients utilized in paddy rice production. Particularly, it involves transplanting single young seedlings with wider spacing, carefully and quickly transplants the seedlings into field that are substantially eliminate continuously flooded, with the soil has more organic matter with minimal or without fertilizer, and is actively aerated.

In the state of the art, there are numerous of seedling trays with different forms of planting cavities have been developed. However, most of the trays provide seedlings in a traumatic manner, wherein roots of the seedlings are tightly interconnected. As such, rendering seedlings grow under stress and experiencing transplanting shock. Likewise, some of the trays make seedlings to grow under a highly competitive environment in seeking for nutrients, oxygen and water. Furthermore, raising seedling under this condition may result in inaccuracy of the transplanter to plant one seedling per hill. Moreover, the existing trays encourage a noticeable percentage of unplanted spaces which eventually forced the farmers to pay for replanting, thus substantially increase in the production cost and also affecting the yield. Yet, it is to be found that some of the existing trays are not mostly followed the System of Rice Intensification (SRI) due to missing spacers, thus did not comply with the SRI requirements.
In view of these and other shortcomings, it is desirous to develop a seedling nursery tray for planting machine, which facilitates good and healthier seedlings for transplanting into the field. Accordingly, the present invention provides a single seedling nursery tray for planting machine, such as for example, a System of Rice Intensification (SRI) planting machine, which provides a new technique of nursing individual, young, delicate seedlings in a good and healthier growth environment for transplanting, and it also facilitates root separation of propagates or plants. The present invention tends to substantially reduce transplanting shock, and ameliorating yield which is proportional to the seedling quality and transplanting pattern.
SUMMARY OF THE INVENTION

The present invention relates generally to a seedling tray. More particularly, the present invention provides a single seedling nursery tray for System of Rice Intensification (SRI) planting machine. Accordingly, a seedling nursery tray for transplanting propagates or plants into field, the seedling nursery tray includes: a) a main tray with plurality of seedling cavities or planting cells disposed therein to enable seedlings grow independently in separated media, wherein the main tray facilitates substantial root disturbance free environment that enables seedling's roots grow deep; and b) a sliding base slidably introduced to the main tray, wherein the sliding base facilitates to serve as a support and/or valve in holding and/or releasing seedlings from the main tray to transplanter for planting into the field.

Accordingly, the main tray of the seedling nursery tray provides conducive environment for individual seedlings with competition free for nutrients, water, sunlight and aeration. Preferably, the main tray of the seedling nursery tray is constructed in substantially rectangular shape having predetermined length, width and height (L x W x H) in accordance with design specifications and/or requirements. It will be appreciated that the main tray of the seedling nursery tray enables numerous of predetermined matrix form of array for viable and vigorous seedlings ready for transplanting. By way of example but not limitation, the main tray of the seedling nursery tray is provided with internal configuration pattern of gridlines to form plurality of array hollow intercalating seedling cavities or planting cells arranged in a matrix form to receive sowing seeds.

In the preferred embodiment, the array section of the main tray may made up of 'm' seedling cavities or planting cells in a row direction and 'n' seedling cavities or planting cells in a column direction arranged in a matrix form, wherein m is equal to or smaller
than n, according to usage requirements. It is to be noted that the main tray of the
seedling nursery tray is further provided with a slot to slidably receive the sliding base.
Accordingly, the slot is preferably provided along at least one side of external boundary
sections of the main tray to receive the sliding base.

It will be appreciated that the seedling nursery tray facilitates planting of single seedling
per hill by dropping mechanism from planter. Accordingly, the nursery tray facilitates the
seedlings transfer to planter board through movements of sliding base to release
seedlings from main tray by dropping the said seedlings to the field. In the preferred
embodiment, the sliding base has a shape in correspondence to the shape of the main
tray. In effect, the sliding base at the main tray of the seedling nursery tray is gradually
removed so as to allow the seedlings to be transferred to transplanter board for final
dropping to the field through opening and closing furrow mechanism of a planting
machine for planting one seedling per hill with respect to the System of Rice
Intensification (SRI) spacing standard.

It should be noted that the seedling nursery tray of the present invention supports the
System of Rice Intensification (SRI) technique implementation of using mechanization.
Preferably, the planting machine of the preferred embodiment is a System of Rice
Intensification (SRI) planting machine.

The present invention is further provided with a seed distribution plate or seeder plate
for transferring sowing or germinated seeds to the seedling nursery tray. Accordingly,
the seed distribution plate or seeder plate has a similar or identical shape and size as
the main tray. In the preferred embodiment, the seed distribution plate or seeder plate is
provided with plurality of predetermined array projection tips arranged in a matrix form,
which serves for placement or sowing the seeds into the seedling cavities / planting cells.
of the seedling nursery tray. By way of example but not limitation, the projection tip of
the seed distribution plate or seeder plate is preferably constructed in a cone-like shape
that serves to facilitate the picking and dropping of seeds to the seedling nursery tray
with the aid of suitable loose solution. It will be appreciated that the seeds are to be
sown in the seedling nursery tray as one per hole with the assistance of a handled
seeder.

It will be appreciated that the seedling nursery tray of the present invention preferably
uses lightweight, weather proof, strong and durable plastic materials to allow multiples
usages as well as can be recycled.

The present invention consists of several novel features and a combination of parts
hereinafter fully described and illustrated in the accompanying description and drawings,
it being understood that various changes in the details may be made without departing
from the scope of the invention or sacrificing any of the advantages of the present
invention.
BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be fully understood from the detailed description given herein below and the accompanying drawings which are given by way of illustration only, and should not be construed as limited to the embodiments set forth herein, and thus are not limitative of the present invention, wherein:

FIG. 1 is a perspective view illustrating a single seedling nursery tray with intercalating seedling cavities or planting cells constructed in accordance with preferred embodiment of the present invention;

FIG. 2 is a partially enlarged bottom perspective view of the seedling nursery tray, particularly to a main tray, according to the preferred embodiment of the present invention;

FIG. 3 is a perspective view illustrating the main tray and a sliding base of the seedling nursery tray in accordance with preferred exemplary of the preferred embodiment;

FIG. 4 is a front perspective view of the main tray illustrating preferred exemplary of the preferred embodiment;

FIG. 5 is an enlarged partially plan view of the main tray illustrating preferred exemplary of the preferred embodiment;

FIGS. 6a and 6b illustrate a seed distribution plate or seeder plate with plurality of array projection tips arranged in a matrix form, for placement or sowing seeds into the
seedling cavities / planting cells of the seedling nursery tray, according to preferred embodiment of the present invention;

FIGS. 7a to 7d illustrate sequences relative to movements of the sliding base of the seedling nursery tray for releasing the seedlings from the main tray into the field in accordance with preferred exemplary of the present invention.
DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention relates to a seedling nursery tray for planting machine. Hereinafter, this specification will describe the present invention according to the preferred embodiments of the present invention. However, it is to be understood that limiting the description to the preferred embodiments of the invention is merely to facilitate discussion of the present invention and it is envisioned that those skilled in the art may devise various modifications and equivalents without departing from the scope of the appended claims.

The present invention generally provides a single seedling nursery tray for planting machine, such as for example, a System of Rice Intensification (SRI) planting machine, which provides a new technique of nursing individual, young, delicate seedlings in a good and healthier growth environment for transplanting. The present invention tends to substantially reduce transplanting shock, and ameliorating yield which is proportional to the seedling quality and transplanting pattern. Accordingly, the said single seedling nursery tray serves to facilitate root separation of propagates or plants, wherein growing medium and root system of each of many propagates or plants can be readily and easily separated in effective manner, thus facilitating growing and subsequent removal of the propagates or plants, and their entire respective root systems in a simple, inexpensive and time-saving manner while at the same time it is efficient in use.

Accordingly, the preferred embodiment of the present invention provides a single seedling nursery tray for planting machine and for used in transplanting propagates or plants into field, the seedling nursery tray generally includes the following features:

i) enables seedlings grow independently in separated media;
ii) facilitates substantial root disturbance free environment that enables seedling's roots grow deep;
iii) provides conducive environment for individual seedlings with competition free for nutrients, water, sunlight and aeration;
iv) facilitates seedlings transfer to planter board through movements of sliding base to release seedlings from main tray by dropping the said seedlings to the field;
v) facilitates planting of single seedling per hill by dropping mechanism from the planter;
vi) enables numerous of predetermined matrix form of array for viable and vigorous seedlings ready for transplanting;
vii) uses lightweight, weather proof, strong and durable materials to allow multiples usages; and
viii) supports System of Rice Intensification (SRI) technique implementation of using mechanization.

The single seedling nursery tray for planting machine, such as for example, a System of Rice Intensification (SRI) planting machine, and for used in transplanting propagates or plants into field according to the preferred embodiments of the present invention will now be described in accordance to the accompanying drawings FIGS. 1 to 7d, either individually or in any combination thereof.

With referring to FIGS. 1 to 5, illustrated therein is a single seedling nursery tray (10) according to preferred embodiments of the present invention. Accordingly, the seedling nursery tray (10) generally includes a main tray (20) with plurality of seedling cavities or planting cells (22) disposed therein, and a sliding base (30) slidably introduced to the main tray (20) to serve as a support and/or valve in holding and/or releasing seedlings from the main tray (20) to transplanter for planting into the field.
By way of example but not limitation, the main tray (20) of seedling nursery tray (10) is preferably constructed in substantially rectangular shape having predetermined length, width and height \((L \times W \times H)\) in accordance with design specifications and/or requirements. Accordingly, the main tray (20) is preferably of rectangular in shape with the length, \(L = 0.635\,\text{m} (635\,\text{mm})\), width, \(W = 0.335\,\text{m} (335\,\text{mm})\), and a total height, \(H = 0.040\,\text{m} (40\,\text{mm})\) respectively.

In the preferred embodiment of the present invention, the main tray (20) of seedling nursery tray (10) is provided with internal configuration pattern of gridlines of ‘\(a \times b\)’ in size, to form plurality of array hollow intercalating seedling cavities or planting cells (22) arranged in a matrix for to receive sowing seeds. It will be appreciated that array section may made up of ‘\(m\)’ seedling cavities or planting cells (22) in a row direction and ‘\(n\)’ seedling cavities or planting cells (22) in a column direction arranged in a matrix form, wherein \(m\) is equal to or smaller than \(n\), according to usage requirements. By way of example but not limitation, each seedling cavity or planting cell (22) is preferably form by gridlines of \(a = 0.015\,\text{m} (15\,\text{mm})\) by \(b = 0.015\,\text{m} (15\,\text{mm})\), separated by a thickness, \(t_{mn}\) of 0.001\,\text{m} (1\,\text{mm})\), and carrying a uniform depth, \(d_{mn}\) of 0.030\,\text{m} (30\,\text{mm})).

It should be noted that the seedling nursery tray (10) may has at least two different thicknesses based on the sizes, configurations, and the uses and/or applications of the tray. Accordingly, the seedling nursery tray (10) may include thickness, \(t_{ex}\) of 0.003\,\text{m} (3\,\text{mm}) being the external boundary sections, and the internal gridlines that separate the seedlings as mentioned, i.e. the thickness, \(t_{mn}\) of 0.001\,\text{m} (1\,\text{mm})).

The main tray (20) of seedling nursery tray (10) is further provided with a slot (24) to slidably receive a sliding base (30). Accordingly, the slot (24) is preferably provided
along at least one side of the external boundary sections of the main tray (20). By way of example but not limitation, the positioning of the slot (24) to the total height, $H$ of the main tray (20) is preferably distributed in a ratio of $H_1$, $H_2$, $H_3 : 6 : 1 : 1$ as shown in FIG. 4, wherein $H_1$, $H_2$ and $H_3$ are respectively set as $H_1 = 0.030m$ (30mm), $H_2 = 0.005m$ (5mm), and $H_3 = 0.005m$ (5mm) to make up a total height, $H$ of 0.040m (40mm).

In the preferred embodiment of the present invention, the shape of the sliding base (30) is in correspondence to the shape of the main tray (20). By way of example but not limitation, said sliding base (30) is preferably constructed in substantially rectangular shape with predefined length, width and thickness $(l \times w \times t)$ of 0.635m (635mm), 0.332m (332mm) and 0.004m (4mm) respectively. It will be appreciated that the thickness, $t$ of 0.004m (4mm) of the sliding base (30) is sufficient to resist and/or support the total load applied to the sliding base (30). Accordingly, the said sliding base (30) facilitates to serve as a support and/or valve in holding and/or releasing any loads, seedlings and/or growth media, from the main tray (20) to transplanter for planting into the field.

The present invention further provided with a seed distribution plate or seeder plate (40) for transferring sowing or germinated seeds to the seedling nursery tray (10). Accordingly, the seed distribution plate or seeder plate (40) is preferably provided with plurality of predetermined array projection tips (42) arranged in a matrix form, which serves for placement or sowing the seeds into the seedling cavities / planting cells (22) of the seedling nursery tray (10). By way of example but not limitation, the said projection tip (42) is preferably constructed in a cone-like shape. Generally, the seed distribution plate or seeder plate (40) has a similar or identical shape and size as the main tray (20). Accordingly, said seed distribution plate or seeder plate (40) has the same rectangular shape, length (635mm) and width (335mm) as the main tray (20), but
with the thickness of 0.004m (4mm). In accordance with preferred embodiment of the present invention, the seed distribution plate or seeder plate (40) is preferably, but not by way of limitation, served with 924 projection tips (42), and each of the projection tip (42) is provided with extruded picker of suitable height of for example, 0.005m (5mm) disposed at bottom surface of the seed distribution plate or seeder plate (40) as shown in FIG. 6b. Said projection tip (42) serves to facilitate the picking and dropping of seeds to the seedling nursery tray (10) with the aid of suitable loose solution.

It will be appreciated that the seeds are to be sown in the seedling nursery tray (10) as one per hole with the assistance of a handled seeder after the preferred growth media has been placed in the seedling cavities or planting cells (22) of the tray which latter rest on the sliding base (30). A thin layer of growth media will then be applied to cover the sown seeds. It is to be noted that the sliding base (30) will remain at the main tray (20) of the seedling nursery tray (10) until seedlings (50) are ready for transplanting.

As soon as the seedlings (50) are ready for transplanting, the seedling nursery tray (10) will be transported to the field and placed on a transplanter board (not shown) with a simple spray of water. Accordingly, once the seedling nursery tray (10) is properly placed on a planter (not shown), the sliding base (30) at the main tray (20) of the seedling nursery tray (10) will be gradually removed so as to allow the seedlings (50) to be transferred to the transplanter board for final dropping to the field through opening and closing furrow mechanism of a planting machine for planting one seedling per hill with respect to the System of Rice Intensification (SRI) spacing standard. The sequences relative to movements of the sliding base (30) of the seedling nursery tray (10) for releasing the seedlings (50) from the main tray (20) to the field in accordance with preferred exemplary of the present invention are illustrated in FIGS. 7a to 7d.
It will be appreciated that the entire tray of the present invention may be made of lightweight, weather proof, strong and durable materials, such as for example, but not limited to suitable plastic materials to allow multiples usages. Accordingly, the preferred plastic materials to be used may be polyvinyl chloride (PVC) due to its mechanical properties of lightweight, weather proof, strong and durable behavioral features, as well as it can be recycled.

It should be understood that all dimensions recited herein are exemplary only, and may be varied depending on circumstances, objectives and requirements, therefore should not be construed as limiting in any way. It should also be noted that sizes and configurations of various structural parts and/or the materials used to construct the above-mentioned parts are illustrative and exemplary only. One of ordinary skill in the art would recognize that those sizes, configurations, and/or materials can be changed to produce different effects or desired characteristics. For example, the array matrix form, shape, size, and/or positioning of the main tray (20) and a sliding base (30) of the seedling nursery tray (10), intercalating seedling cavities or planting cells (22) of the seedling nursery tray (10) and the seeder plate (40) may be altered as desired, and the various disclosed dimensions of the various lattice or geometrical structures may also be changed so as to achieve desired output characteristics or to reach an optimal solution.

The invention being thus described, it will be obvious that the same may be varied in many ways. Such variations are not to be regarded as a departure from the principle and scope of the invention, and all such modifications as would obvious to one skilled in the art intended to be included within the scope of following claims.
CLAIMS

1. A seedling nursery tray for transplanting propagates or plants into field, the seedling nursery tray (10) includes:
   a) a main tray (20) with plurality of seedling cavities or planting cells (22) disposed therein to enable seedlings grow independently in separated media;
   b) a sliding base (30) slidably introduced to the main tray (20);
wherein the main tray (20) facilitates substantial root disturbance free environment that enables seedling's roots grow deep; and
wherein the sliding base (30) facilitates to serve as a support and/or valve in holding and/or releasing seedlings from the main tray (20) to transplanter for planting into the field.

2. The seedling nursery tray according to Claim 1, wherein the main tray (20) of the seedling nursery tray (10) provides conducive environment for individual seedlings with competition free for nutrients, water, sunlight and aeration.

3. The seedling nursery tray according to Claim 1 or 2, wherein the main tray (20) of the seedling nursery tray (10) is preferably constructed in substantially rectangular shape having predetermined length, width and height (L x W x H) in accordance with design specifications and/or requirements.

4. The seedling nursery tray according to Claim 1 or 3, wherein the main tray (20) of the seedling nursery tray (10) enables numerous of predetermined matrix form of array for viable and vigorous seedlings ready for transplanting.
5. The seedling nursery tray according to Claim 1 or 4, wherein the main tray (20) of the seedling nursery tray (10) is provided with internal configuration pattern of gridlines to form plurality of array hollow intercalating seedling cavities or planting cells (22) arranged in a matrix form to receive sowing seeds.

6. The seedling nursery tray according to Claim 4 or 5, wherein the array section may made up of 'm' seedling cavities or planting cells (22) in a row direction and 'n' seedling cavities or planting cells (22) in a column direction arranged in a matrix form, wherein m is equal to or smaller than n, according to usage requirements.

7. The seedling nursery tray according to Claim 1, 5 or 6, wherein the main tray (20) of the seedling nursery tray (10) is further provided with a slot (24) to slidably receive the sliding base (30).

8. The seedling nursery tray according to Claim 7, wherein the slot (24) is preferably provided along at least one side of external boundary sections of the main tray (20).

9. The seedling nursery tray according to Claim 1, 6 or 8, wherein the seedling nursery tray (10) facilitates planting of single seedling per hill by dropping mechanism from planter.

10. The seedling nursery tray according to Claim 1 or 9, wherein the nursery tray (10) facilitates the seedlings transfer to planter board through movements of sliding base (30) to release seedlings (50) from main tray (20) by dropping the said seedlings (50) to the field.
11. The seedling nursery tray according to Claim 1 or 10, wherein the sliding base (30) has a shape in correspondence to the shape of the main tray (20).

12. The seedling nursery tray according to Claim 1 or 11, wherein the sliding base (30) at the main tray (20) of the seedling nursery tray (10) is gradually removed so as to allow the seedlings (50) to be transferred to transplanter board for final dropping to the field through opening and closing furrow mechanism of a planting machine for planting one seedling per hill with respect to the System of Rice Intensification (SRI) spacing standard.

13. The seedling nursery tray according to Claim 12, wherein the planting machine is a System of Rice Intensification (SRI) planting machine.

14. The seedling nursery tray according to Claim 1 or 13, wherein the seedling nursery tray (10) supports the System of Rice Intensification (SRI) technique implementation of using mechanization.

15. The seedling nursery tray according to Claim 1, wherein the seedling nursery tray (10) is further provided with a seed distribution plate or seeder plate (40) for transferring sowing or germinated seeds to the seedling nursery tray (10).

16. The seedling nursery tray according to Claim 15, wherein the seed distribution plate or seeder plate (40) has a similar or identical shape and size as the main tray (20).
17. The seedling nursery tray according to Claim 16, wherein the seed distribution plate or seeder plate (40) is provided with plurality of predetermined array projection tips (42) arranged in a matrix form, which serves for placement or sowing the seeds into the seedling cavities / planting cells (22) of the seedling nursery tray (10).

18. The seedling nursery tray according to Claim 17, wherein the projection tip (42) is preferably constructed in a cone-like shape that serves to facilitate the picking and dropping of seeds to the seedling nursery tray (10) with the aid of suitable loose solution.

19. The seedling nursery tray according to Claim 18, wherein the seeds are to be sown in the seedling nursery tray (10) as one per hole with the assistance of a handled seeder.

20. The seedling nursery tray according to Claim 1, wherein the seedling nursery tray (10) uses lightweight, weather proof, strong and durable plastic materials to allow multiples usages as well as can be recycled.
**A. CLASSIFICATION OF SUBJECT MATTER**

A01C 7/02(2006.01)i, A01C 7/10(2006.01)i

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)

A01C 7/02; C12M 1/00; C12N 13/00; A01G 1/00; A01G 9/02; A01G 9/10; A01C 7/10

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

Korean utility models and applications for utility models

Japanese utility models and applications for utility models

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

eKOMPASS(KIPO internal) & keywords: seedling, nursery tray, plant, main tray, sliding base, cavities, transplanter, seeder plate, projection tip

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

<table>
<thead>
<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<tbody>
<tr>
<td>Y</td>
<td>US 6237286 BI (WILLIAMES, G. A.) 29 May 2001 abstr act; column 1, lines 56-65 and column 6, lines 30-55; claims 1 and 7; figures 1 and 4-7.</td>
<td>1-3, 15-20</td>
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<td>A</td>
<td>EP 2324696 AI (TSONAKIS, L. et al.) 25 May 2011 See abstr act; claims 1-3; figures 1-5.</td>
<td>1-3, 15-20</td>
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<td>A</td>
<td>US 5274953 A (NICHOLSON, S.) 4 January 1994 See claims 1-2; figures 1-2.</td>
<td>1-3, 15-20</td>
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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
  *"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 novel or 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: 03 September 2014 (03.09.2014)

Date of mailing of the international search report: 04 September 2014 (04.09.2014)

Name and mailing address of the ISA/KR

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Form PCT/ISA/210 (second sheet) (July 2009)
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.: 8, 13
   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:
   Claims 8 and 13 are unclear since they are referring to the multiple dependent claims which do not comply with PCT Rule 6.4(a).

3. ☒ Claims Nos.: 4-7,9-12,14
   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:

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 an additional fees, this Authority did not invite payment of any 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.:  

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.

Form PCT/ISA/210 (continuation of first sheet (2)) (July 2009)
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