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(54) Title: METHOD AND DEVICE FOR TAKING SAMPLES FROM PLANTS

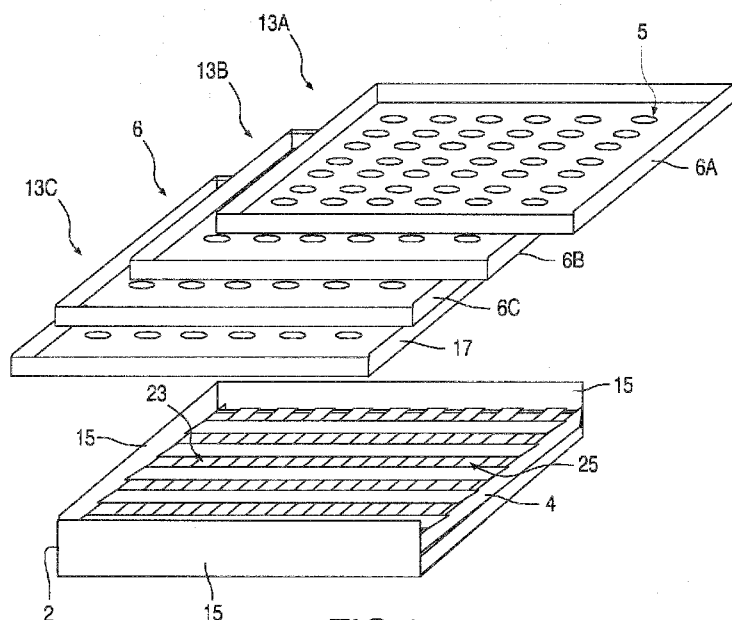


FIG.3

(57) Abstract: The invention relates to a method of sampling a plurality of plants (1), the method comprising: providing a plurality of plants arranged in a grid (23), providing a plurality of compartments (5) arranged in at least one grid (13), - positioning a section of each plant in each compartment, such that each compartment houses a plant section from only one plant, cutting the plants with a cutting device (8) such that the plant sections in the respective compartments become separated from the plants, and collecting the plant sections from the respective compartments for later use as samples. The invention further relates to a device for carrying out the method.

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Title: Method and device for taking samples from plants

FIELD OF THE INVENTION

The present invention relates to a method and a device for taking samples from a plurality of plants, in particular for obtaining DNA samples from a plurality of plants.

5 PRIOR ART

In present day methods for improving crops, use is often made of DNA analysis for selection purposes. Generally, a large number of plants are grown, wherein methods are applied for analysing many plants with a multitude of different DNA genotypes. In other instances, mutagenic treatments may be applied to generate random DNA variation in large
10 plant populations.

Next, samples are taken from the group of plants. These samples are tested with DNA testing methods. Next, a selection is made from the group of samples which sample(s) has the most suitable DNA to meet the requirements. The plant or plants from which the sample was taken can then be used as a starting material for further crop development. For
15 instance, cuttings can be taken from this plant and these cuttings can be grown into a next generation of plants.

This sequence of growing, sampling, testing and selecting can be repeated for several generations, until a required crop is obtained.

The taking of samples from the plants is generally performed manually. With a
20 handheld tool, several samples are taken from each plant. Generally, three samples are taken from each plant. This is a time consuming and cumbersome process.

A mechanized method of separating parts from plants also exists. US2006112619 describes a method for separating a lump piece from rosette plants. The method includes the steps of gripping a rosette plant and positioning it parallel to a longitudinal axis of an
25 elongated holder which has a longitudinal opening at least along the longitudinal axis. It then introduces a part of the lump piece of the rosette plant into the holder via the mentioned longitudinal opening. The next step is then cutting off the lump piece, while closing the longitudinal opening, such that the introduced part of the lump piece is enclosed in the holder. The enclosed cut-off part of the lump piece is then removed from the holder. The
30 method includes the further step of cutting off a part of the rosette plant enclosed in the holder along a second cutting plane.

However, when the group of plants which needs to be sampled is quite large, the method of US2006112619 requires much processing actions and is time consuming. The method is also inadequate if one wants to take multiple samples from each plant. The method of US2006112619 is also not very suitable for DNA sampling.

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OBJECT OF THE INVENTION

It is an object of the present invention to provide a method and device for efficiently sampling a substantial number of plants, in particular for DNA analysis.

10 SUMMARY OF THE INVENTION

The invention provides a method for sampling a plurality of plants, the method comprising:

- providing a plurality of plants arranged in a grid,
- providing a plurality of compartments which – in top view – define openings which
15 are arranged in a grid,
- positioning the plants such that only one plant extends through each opening,
- cutting the plants with a cutting device such that plant sections which extend through the respective openings become separated from the respective plants, and
- 20 - collecting the plant sections for later use as samples.

With the invention, it is possible to collect the samples efficiently. In a suitable embodiment, the plants in the grid can be sampled in a single operation. The samples remain behind in the respective compartments. These samples can then be collected and analyzed, for instance with DNA testing methods known in the field of the art. Other
25 methods of analysis than DNA analysis are also possible, for instance regular chemical or physical tests.

In an embodiment, the method comprises:

- providing a plurality of plants arranged in a grid,
- providing a plurality of compartments arranged in at least one grid,
- 30 - positioning a section of each plant in each compartment, such that each compartment houses a plant section from only one plant,
- cutting the plants with a cutting device such that the plant sections in the respective compartments become separated from the plants, and
- collecting the plant sections from the respective compartments for later use as
35 samples.

Generally, the plants are positioned on a plant support under the grid of compartments.

In an embodiment, the method comprises:

- providing the grid of compartments above the plants or above seeds, and
- letting the plants or seeds grow through the at least one grid of compartments in such a way that through each compartment only one plant.

5 The compartments and cutting device may be provided above the plants or seeds and the plants may grow upwards through the compartments. However, if the roots of the plants need to be sampled, the compartment grids and cutting device are arranged underneath the plant support and the plants may grow downwards through the compartments.

10 In this way, the plants position themselves inside the compartments. No positioning is required, as long as the compartments are positioned directly above the respective plants. It is also possible to start with seeds instead of plants.

In an embodiment, the method comprises:

- providing at least:
 - 15 o a first grid of compartments and
 - o a second grid of compartments, wherein each compartment of the first grid is associated with a compartment of the second grid,
- providing a first section of each plant in a compartment of the first grid of compartments and a providing a second section of that plant in the associated
- 20 compartment of the second grid of compartments,
- cutting the plants with the cutting device such that for each plant the first plant section in the compartment of the first grid of compartments and the second plant section in the compartment of the second grid of compartments become
- 25 separated from the plant, and
- collecting the first plant section and the second plant section of each plant from the respective compartments of the first and second grid of compartments.

With this method, it is possible to collect multiple samples from a single plant. For instance, this allows pooling samples in rows and columns of the grid of compartments. With relatively few tests, the plant with the “best” DNA can be identified in a large grid of plants.

30 This is further explained below.

In an embodiment, the method comprises:

- providing a third grid of compartments, wherein each compartment of the third grid of compartments is associated with a compartment of the first grid of compartments and with a compartment of the second grid of compartments,
- 35 - providing a first section of each plant in a compartment of the first grid of compartments and a second section of each plant in an associated

compartment of the second grid of compartments, and a third section of each plant in an associated compartment of the third grid of compartments,

- cutting the plant such that the first plant section, second plant section and third plant section become separated from the plant, and
- 5 - collecting the first plant section, second plant section and third plant section of each plant from the respective compartments.

With three grids of compartments, samples from two grids can be use to identify the “best” plant in the grid of plants, and the samples from the third grid compartment can be used e.g. to create next generations of plants for vegetative propagation, or for any other
10 purpose relating to additional plant analyses.

In an embodiment, the grids of compartments are positioned above one another. This is a practical way of carrying out the invention.

In an embodiment, the method comprises aligning the associated compartments of the grids of compartments with one another prior to providing the plants in the
15 compartments.

In an embodiment, the compartments comprise an opening at a bottom end of the compartment, and wherein the cutting of the plants comprises cutting the plants at least at the bottom end of the compartments.

It is also possible to cut the plant both near the bottom end and near the top end of
20 the compartment. The length of the plant section will correspond substantially with a height of the compartment.

In an embodiment, the method comprises:

- holding the separated plant sections in the compartments until all the plants in the grid of compartments have been cut, and
- 25 - subsequently collecting the separated plant sections from the compartments.

In this way, the collecting of the samples can be carried out as a structured process, subsequent to the cutting of the planet sections

In an embodiment, said cutting device has a second function of forming a closure of the bottom ends of the compartments after cutting the plants of said grid of compartments,
30 wherein the closure prevents the separated plant section from dropping out of the compartments prior to the collecting of the plant sections from the compartments.

In an embodiment, the first grid of compartments is formed in a first compartment tray and the second grid of compartments is formed in a second compartment tray.

A tray can be provided with cavities which in a simple fashion can form the
35 compartments.

In an embodiment, the cutting device is integrally formed as cutting edges in the at least first and/or second compartment trays, the method comprising moving the first

compartment tray and second compartment tray relative to one another for the cutting of the plants.

In this way, there is no need for a separate cutting device. The cutting device is integrated with the grid of compartments and provides a simple embodiment.

5 In an embodiment, each grid of compartments comprises a plurality of rows and a plurality of columns, the method comprising:

- 10 - providing a plurality of plant section holders, one for each row of the first grid of compartments and collecting the separated plant sections in the first grid of compartments row by row in a respective plant section holder such that the plant sections from each row are stored together in the respective plant section holder of that row,
- 15 - providing a plurality of plant section holders, one for each column of the second grid of compartments, and collecting the separated plant sections in the second grid of compartments column by column in a respective plant section holder such that the plant sections from each column are stored together in the respective plant section holder of that column.

In this way, the samples can be pooled, which leads to a reduced number of DNA tests for identifying the "best" plant in the grid of plants. Other advantages may also be present.

20 In an embodiment, the separated plant sections of the third grid of compartments are stored individually, for later use of the separated plant sections.

In an embodiment, the provided device comprises:

- 25 ○ a first series of compartments in the form of slots extending in a first slot direction, the first series of slots being arranged above the plant grid,
- a second series of compartments in the form of slots extending in a second slot direction which is different from the first slot direction, the second series of slots being provided below the first series of slots, wherein in top view the first and second series of slots define the openings which are arranged in a grid,
- 30 ○ a first cutting plate arranged below the first series of slots, the first cutting plate being constructed to move in a first cutting direction which is different from the first slot direction,
- a second cutting plate arranged below the second series of slots, the second cutting plate being constructed to move in a second cutting direction which is different from the second slot direction,
- 35

the method comprising:

- providing the plant through the openings, such that only one plant extends through each opening, and such that a first section of each plant extends in a slot of the first series of slots and a second section extends in a slot of the second series of slots,

5 - cutting the plants with the first cutting plate by moving the first cutting plate along the underside of the first series of slots in the first cutting direction

- cutting the plants with the second cutting plate by moving the second cutting plate along the underside of the second series of slots in the second cutting direction, such that multiple plant sections remain behind in each slot of the first series of slots and multiple plant sections remain behind in each slot of the second series of slots, and

10

collecting the plant sections from the respective slots for later use as samples.

In an embodiment of the method, after the cutting and prior to the collecting, the cut plant sections in at least one grid of compartments remain confined within boundaries of the respective compartments.

15

The present invention further relates to a device for taking samples from a plurality of plants, the device comprising:

- a plant support for supporting a plurality of plants arranged in a grid,
 - a plurality of compartments arranged above or below the plant support
- 20 wherein the plurality of compartments – in top view – define openings which are arranged in a grid,
- a cutting device constructed for cutting plant sections from plants which extend upwardly or downwardly from the plant support through the openings.

20

The device provides substantially the same advantages as the method of the

25 invention.

In an embodiment, the device comprises:

- a plurality of compartments arranged in at least one grid of compartments above or below the plant support, wherein the compartments define the openings,
- 30 - a cutting device constructed for cutting plant sections from plants which extend upwardly or downwardly from the plant support into the compartments.

30

To ensure that, when growing, the plants do not interfere with each other, the grid of compartments corresponds with the grid of plants, and the compartments are placed above the bedding. This allows the plants to grow individually into the compartments.

35

For some species of plants, it may also be possible to let the plants grow first, and to subsequently position the grid of compartments such that only one plant extends in each compartment.

In an embodiment, the plurality of compartments is arranged in at least one grid.

In an embodiment, the device comprises:

- at least a first grid of compartments,
- at least a second grid of compartments,

5 wherein each compartment of the first grid of compartments is associated with a compartment of the second grid of compartments, and wherein the first and second grids of compartments are configured such that in use a plant extends through both grids of compartments such that a first section of each plant extends in a compartment of the first grid of compartments and a second section of that plant extends in the associated compartment of the second grid of compartments, and wherein the cutting device is configured for cutting the plants such that for each plant the first plant section in the compartment of the first grid of compartments and the second plant section in the compartment of the second grid of compartments become separated from the plant,.

10 In an embodiment, the first grid of compartments and the second grid of compartments are constructed to be placed above one another.

In an embodiment, the device comprises a third grid of compartments, wherein each compartment of the third grid of compartments is associated with a compartment of the second grid of compartments and with a compartment of the first grid of compartments.

15 In an embodiment, each grid of compartments is provided as a plurality of cavities in a compartment tray.

In an embodiment, the at least first and second grid of compartments are moveable relative to one another, wherein each compartment of the first grid of compartments comprises at least one cutting edge at a lower end of said compartment, the cutting edge being configured to cooperate with a cutting edge of an associated compartment in the second grid of compartments for separating the plant section in the compartment from the plant during the moving of the first grid relative to the second grid.

20 In another embodiment, the cutting device comprises at least one plate with at least one cutting edge, the plate being movable relative to a grid of compartments along bottom ends of the respective compartments of said grid of compartments.

In an embodiment, the at least one plate is movable between the first grid of compartments and the second grid of compartments.

In an embodiment, each grid of compartments is removable from the device in order to collect the plant sections from said grid of compartments.

25 In an embodiment, the device comprises:

- o a first series compartments in the form of slots extending in a first slot direction, the first series of slots being arranged above or below the plant grid,

- a second series of compartments in the form of slots extending in a second slot direction which is different from the first slot direction, the second series of slots being provided below the first series of slots, wherein in top view the first and second series of slots define openings arranged in a grid,
- 5 ○ a first cutting plate arranged below the first series of slots, the first cutting plate being constructed to move in a first cutting direction which is different from the first slot direction

a second cutting plate arranged below the second series of slots, the second cutting plate being constructed to move in a second cutting direction which is different from the
10 second slot direction.

In an embodiment of the device, at least one grid of compartments and the cutting device are arranged such that after the cutting and prior to the collecting of the cut plant sections, the cut plant sections in at least one grid of compartments remain confined within boundaries of the respective compartments.

15

BRIEF DESCRIPTION OF THE DRAWINGS

The previous and other features and advantages of the present invention will be more fully understood from the following detailed description of exemplary embodiments with reference to the attached drawings, in which:

20 Figure 1 shows a view of the device according to the invention comprising one tray with plant holders in a grid and one tray in a grid with compartments and, as an example, one plant grown through one compartment.

Figure 2 shows an exploded view of the device according to the invention comprising one tray with a grid with plant holders.

25 Figure 3 shows a view of the device according to the invention comprising one tray with a grid with plant holders and multiple trays with grids with compartments.

Figure 4 shows a cross-sectional view of multiple trays with a grid with compartments.

30 Figure 5 shows a cross-sectional view of multiple trays with one plant extending through the compartments.

Figure 6 shows a cross-sectional view of multiple trays with one plant extending through the compartments with the top section of the plant cut off and separated from the whole plant by the top tray.

35 Figure 7 shows a cross-sectional view of multiple trays with one plant extending through the compartments with the top section of the plant cut off and separated and removed from the whole plant by the top tray.

Figure 8 shows a cross-sectional view of multiple trays with one plant extending through the compartments with the top tray removed containing a separated plant section within a compartment.

Figure 9 shows a cross-sectional view of the trays wherein the plant is cut into three sections by the movement of the middle tray, and wherein the cut sections are separated and contained within the compartments.

Figure 10 shows the same embodiment as shown in figure 9, but with the removal of the top separated plant section from its compartment.

Figure 11 shows a cross-sectional side view of another embodiment of the invention wherein the cutting device has moveable plates with a sharp edge to cut the plants.

Figure 12 shows a cross-sectional side view of the embodiment of figure 11 after cutting the plants.

Figure 13 shows a procedure of collecting samples from the compartments.

Figure 14 shows a side view of another embodiment of the invention.

Figure 15 shows a top view of the embodiment of figure 15.

DETAILED DESCRIPTION OF THE FIGURES

Figures 1 and 2 show a plant sampling device 10 according to the invention comprising a container 2 which accommodates a plant holder 4, a compartment tray 6 which defines a grid of compartments 13 (also referred to as compartment grid 13), and one plant 1 extending through one compartment 5 of the compartment tray 6. The single plant 1 is shown as an example, but the skilled person will understand that in use, there will be a large number of plants 1 extending through the compartments. The plants are arranged in a plant grid 23 which has rows 7 and columns 9.

In top view, the plant sampling device 10 can for instance be square or rectangular in shape.

The compartment grid 13 has a number of rows 7 and a number of columns 9. The compartment grid 13 has the same number of rows and columns as the plant grid 23. In top view, the shape and size of the compartments 5 can be circular, oval, square or any other shape suitable to accommodate at least one plant in it. A particular suitable shape of the compartment 5 is a circular shape.

In figure 2 the container 2 and the plant holder 4 are – for clarity purposes - separated from each other. The container 2 is constructed to hold the plant holder 4. The plant holder 4 has a grid 23 of plant positions 25, wherein a plant position 25 can contain a plant 1.

It is also possible to plant a seed 1 in the plant position and let the seed grow.

The plant position 25 generally comprises soil or another substrate for the plant to grow in.

Figure 3 shows the container 2 in an exploded view holding the plant holder 4 and multiple compartment trays 6A, 6B, 6C which are stacked onto each other within the container 2. Each compartment tray 6A, 6B, 6C defines a respective grid of compartments 13A, 13B, 13C. In order to support the plant holder 4 and the compartment trays 6, the plant holder is provided with a base 19 and upstanding side walls 15 on three sides. One side is open, allowing the plant holder 4 and the compartment trays 6 to be inserted and removed.

The compartment trays 6A, 6B, 6C may have supports points via which the compartment trays 6A, 6B, 6C can be stacked onto one another. Alternatively, the side walls 15 may have supports via which the compartment trays 6A, 6B, 6C can rest on the side walls 15.

The plant grid 23 and each compartment grid 13A, 13B, 13C define respective, substantially straight planes, which planes extend parallel to one another.

Each compartment grid 13A, 13B, 13C is provided at a different level above the plant grid 23, i.e. at a different distance from the plant grid 23.

Figure 3 also shows a cutting plate 17, the details of which will be explained further below.

Figure 4 shows a cross-section of multiple compartment trays 6A, 6B, 6C stacked onto each other. Each compartment 5a of one compartment tray 6A is aligned with an associated compartment 5B, 5C in each of the other compartment trays 6B, 6C. This allows each plant 1 to extend through the compartments 5A, 5B, 5C. The compartments 5 are formed as cavities in the compartment trays 6. The compartments 5 each have a side wall 19 and an opening 20 at a bottom end 21 and an opening 22 at a top end 23.

It can be seen that the compartments define openings 59 through which a plant can grow. In a practical embodiment, at least 100 openings are provided. The openings are provided in a grid 13.

The trays 6 and the compartments 5 have a height 34. The height is chosen to obtain a sample with a required length. The height 34 of the compartments may for instance be between 5 and 50 mm. If the plant section is cut both at the bottom as at the top of the compartment, a length of the separated plant section will correspond substantially with the height of the compartments 5.

Figure 5 shows a cross-sectional side view of three compartment trays 6A, 6B, 6C for one column of compartments 5, with one plant 1 extending through the respective compartments 5A, 5B, 5C. Cutting edges 8 are provided at the upper or lower end of each compartment 5A, 5B, 5C. In figure 5, only one compartment 5 per compartment tray 6 is

shown, but the dash-dotted lines 9 indicate that there are a multitude of compartments 5 for each compartment tray 6. Each compartment accommodates one plant 1 only.

In side view, each compartment 5A has a form which tapers outwardly in upward direction. In side view, each compartment 5B, 5C has a — form which – in upward direction 5 - first tapers outwardly and subsequently tapers inwardly. These forms are practical, because cutting edges 8 are formed at the upper and lower ends of each compartment 5b, 5b and at the lower end of compartments 5A.

Figure 6 shows the top section of the plant 1A being cut off by the cutting edges 8A of compartment tray 6A while the compartment tray 6A is being moved to the left 27. The 10 movement to the left 27 can also be done to the right and will result in the same cutting effect. The movement 27 of the compartment tray 6A can be done manually or by a (e.g. electric) drive. The upper side 30 of compartment tray 6B functions as a closure member for the bottom end of compartment 5A. The top section 1a is the first sample taken from plant 1.

Figure 7 shows the remaining plant 1 in the compartments sections 5. The separated 15 plant section 1A is collected from its compartment 5A. The separated plant section 1a are collected for further usage, for instance for DNA testing.

Figure 8 shows the remaining plant 1 extending in the compartments sections 5b, 5c in the remaining compartment trays 6B, 6C. Compartment tray 6A has been removed in order to gain access to compartments 5B in compartment tray 6B.

20 Figure 9 shows that compartment tray 6C is moved to the left 31 relative to compartment tray 6b and cutting plate 17. This movement cuts two more plant sections 1B, 1C from the plant 1. The plant sections 1B, 1C, remain in their respective compartments 5B, 5C. The plant 1 is cut by the cutting edges 8C of the compartment 5C in the compartment tray 6C. By moving the compartment tray 6C to the left 31, the plant 1 is cut. The separated 25 plant sections 1B, 1C are contained within their respective compartments 5B, 5C by the upper surface 30 of the neighbouring compartment tray 6C and the upper surface 30 of cutting plate 17.

Figure 10 shows the removal of the separated plant section 1B from its respective compartment 5B of the upper compartment tray 6B. The remaining separated plant section 30 1C in its compartment 5C in the remaining compartment tray 6C can also be removed in the same manner as described in the previous. First, compartment tray 6 B is removed, and then the samples 1C are collected.

Three samples 1A, 1B and 1C have been collected from each plant. For the compartment tray 6B, the plant samples 1B are collected row by row and stored in a sample 35 holder per row. Thus, if there are 100 rows by 200 columns of plants 1 in the grid 23, i.e. 20.000 plants, the samples 1B from compartment tray 6B are collected in 100 holders, one holder for each row.

For the compartment tray 6C, the plant samples are collected column by column and stored in a sample holder per column. Thus, if there are 100 rows by 200 columns of plants 1 in the grid 23, the samples 1C from compartment tray 6C are collected in 200 holders.

For this example, there are in total 300 holders. The DNA of these 300 holders can be analyzed. According to criteria, the samples are then used for selecting the plant 1 with the "best" DNA. Of the 20.000 plants, the plant sample 1A of the plant with the best DNA is used for further processing. This 1 plant may be used for creating a next generation of crops.

With the device and method according to the invention, a large number of plants can be sampled, and three separate samples of each plant can be taken. This can be done efficiently and reliably.

Figure 11 shows a second embodiment 20 of the plant sampling device 10 comprising a plurality of compartment trays 6 comprising a plurality of compartments and a plurality of cutting devices 14A, 14B, 14C, 14C. The compartment trays 6 are rectangular or square of shape and their respective compartments 5 can be of any shape placed in a grid-like manner containing at least one plant 1. When seen from above, the cutting devices 14 have a similar shape, as the compartment trays 6 and are constructed to slide between the compartment trays 6. Guides may be provided for guiding the plates 14A, 14B, 14C, 14C. The dashed lines 13 indicate that although only one compartment 16 is shown per compartment tray 6, in fact there are a multitude of compartments 5 per compartment tray 6. Three compartment trays 6A, 6B, 6C are shown. A minimum of two compartment grids is required, in order to be able to use the row 7 and column 9 for pinpointing the original the plant from which the separated plant sections were taken.

Figure 12 shows the plant sampling device 10 with the cutting devices 14A, 14B, 14C, 14D moved between the individual compartment trays 6A, 6B, 6C and thus cutting the plant 1 into separate plant sections 1A, 1B, 1C, and the remainder of the original plant 1. The cutting plates 14A, 14B, 14C, 14C move in direction 31.

Except for the top separated plant section 11A and the bottom separated plant section 11F, the other separated plant sections 1B, 1C are contained within their respective compartments 5B, 5C by the upper surfaces of the neighbouring cutting devices 14B, 14C, 14D. For instance, cutting device 14D serves as the bottom surface of compartment 5C. Each cutting device 14A, 14B, 14C can be removed with the compartment tray 6A, 6B, 6C resting above it. For instance, compartment tray 6C rests above cutting device 14D which serves as the lower surface of compartment 5C containing separated plant section 1C.

Turning to figure 13, a procedure for collecting the samples from the compartments 5 is shown. The shown plant grid 23 has 11 rows 7 and 16 columns 9. In total there are 176

plants. There are two grids 13A, 13B of compartments 5. The grid 23 of plants and the grids 13A, 13B of compartments are shown in top view and thus overlies one another.

When the plant sections (or samples) are collected, the plant sections 1A of grid 13A of compartments are collected per row 7 into a row holder 36 for each row 7. This is indicated with arrow 37.

The samples 1B of grid 13B are collected per column 9 into a column holder 38. This is indicated by arrow 39.

Each row holder 36 contains 16 samples and each column holder 38 contains 11 samples. These samples are tested as a pool, i.e. 27 tests are performed. On the basis of the tests, it is possible to determine the best row 41 and the best column 42 and identify the plant 40 with the "best" DNA with a limited number of tests. Other characteristics of the plants may also be tested in pools. In this way, for a grid of n rows by m columns it is possible to identify the best plant 40 with two grids 13A, 13B of compartments and a total of n+m tests.

There may be other reasons for taking multiple samples from one plant, for instance to obtain backup samples for verification purposes.

Turning to figures 14 and 15, another embodiment is shown. Instead of individual compartments for individual plants, two series 50, 52 of compartments in the form of slots 51, 53 are provided. The series of slots are provided in two slot trays 56, 58. Underneath each slot tray 58, 58, a cutting plate 14A, 14B is arranged which is movable in a cutting direction. The slots 51 extend in a main direction and the slots 53 extend in a transverse main direction.

In top view the two series of slots define openings 59 through which a plant may grow. The openings form a grid 13 of openings. The openings can also be likened to channels. The channels extend substantially vertically.

In operation, the plants are cut with the first cutting plate 14A by moving the first cutting plate along the underside of the first series of slots in the first cutting direction 31. The plants are also cut with the second cutting plate 14B by moving the second cutting plate along the underside of the second series 52 of slots 53 in the second cutting direction 32, such that multiple plant sections remain behind in each slot 51 of the first series of slots and multiple plant section remain behind in each slot 53 of the second series of slots.

The cutting plates 14A 14B which are shown are smaller than the grid 13, but a skilled person will understand that generally, the cutting plates will have the same size as the grid 13, so that all slots can be closed at the bottom end by the cutting plates after the cutting action.

The plant sections in each slot can be collected in a row holder and a column holder similar to the procedure shown in figure 13.

It will be obvious to a person skilled in the art that the details and the arrangement of the parts may be varied over considerable range without departing from the spirit of the invention and the scope of the claims.

Claims

1. Method of taking samples from a plurality of plants (1), the method comprising:
 - providing a plurality of plants arranged in a grid (23),
 - providing a plurality of compartments (5; 51; 53) which – in top view – define openings (59) which are arranged in a grid (13),
 - 5 - positioning the plants such that only one plant extends through each opening (59),
 - cutting the plants with a cutting device (8) such that plant sections which extend through the respective openings become separated from the respective plants, and
 - 10 - collecting the plant sections for later use as samples.
2. Method according to claim 1, the method comprising:
 - providing a plurality of compartments (5) arranged in at least one grid (13), wherein the compartments define the openings,
 - 15 - positioning a section (1A, 1B, 1C) of each plant in each compartment, such that each compartment houses a plant section from only one plant,
 - cutting the plants with a cutting device (8) such that the plant sections in the respective compartments become separated from the plants, and
 - collecting the plant sections from the respective compartments for later use as samples.
 - 20
3. Method according to claim 2, the method comprising:
 - providing the grid of compartments near the plants (1) or near seeds (1), and
 - letting the plants or seeds grow through the at least one grid of compartments in
 - 25 such a way that only one plant grows through each compartment.
4. Method according to claim 2 or 3, comprising:
 - providing at least:
 - a first grid of compartments (13A) and
 - a second grid of compartments (13B), wherein each compartment of the
 - 30 first grid is associated with a compartment of the second grid,
 - providing a first section (1A) of each plant (1) in a compartment (5A) of the first grid of compartments and a providing a second section (1B) of that plant in the associated compartment (5B) of the second grid of compartments,

- cutting the plants with the cutting device (8) such that for each plant the first plant section in the compartment of the first grid of compartments and the second plant section in the compartment of the second grid of compartments become separated from the plant, and
 - 5 - collecting the first plant section and the second plant section of each plant from the respective compartments of the first and second grid of compartments.
5. Method according to claim 4, comprising:
- 10 - providing a third grid of compartments (13C), wherein each compartment (5C) of the third grid of compartments is associated with a compartment of the first grid of compartments and with a compartment of the second grid of compartments,
 - 15 - providing a first section (1A) of each plant in a compartment (5A) of the first grid of compartments and a second section (1B) of each plant in an associated compartment (5B) of the second grid of compartments, and a third section (1C) of each plant in an associated compartment (5C) of the third grid of compartments,
 - 20 - cutting the plant such that the first plant section, second plant section and third plant section become separated from the plant, and
 - collecting the first plant section, second plant section and third plant section of each plant from the respective compartments.
6. Method according to claim 4 or 5, wherein the grids of compartments are positioned above one another.
- 25
7. Method according to any of claims 4-6, the method comprising aligning the associated compartments of the grids of compartments with one another prior to providing the plants in the compartments.
- 30
8. Method according to any of the previous claims, wherein the compartments comprise an opening (20) at a bottom end (21) of the compartment, and wherein the cutting of the plants comprises cutting the plants at least at the bottom end of the compartments.
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9. Method according to any of the previous claims, comprising:
- holding the separated plant sections in the compartments until all the plants in the grid of compartments have been cut, and

- subsequently collecting the separated plant sections from the compartments.

10. Method according to any of the previous claims, wherein said cutting device has a second function of forming a closure (30) of the bottom ends of the compartments after cutting the plants of said grid of compartments, wherein the closure prevents the separated plant section from dropping out of the compartments prior to the collecting of the plant sections from the compartments.

11. Method according to any of claims 5-10, wherein the first grid of compartments is formed in a first compartment tray (6A;56) and wherein the second grid of compartments is formed in a second compartment tray (6B;58)

12. Method according to claim 11, wherein the cutting device is integrally formed as cutting edges (8) in the at least first and/or second compartment trays, the method comprising moving the first compartment tray and second compartment tray relative to one another for the cutting of the plants.

13. Method according to any of claims 4 - 12, wherein each grid of compartments comprises a plurality of rows (7) and a plurality of columns (9), the method comprising:

- providing a plurality of plant section holders, one for each row (7) of the first grid (13A) of compartments and collecting the separated plant sections in the first grid of compartments row by row in a respective plant section holder such that the plant sections from each row are stored together in the respective plant section holder of that row,
- providing a plurality of plant section holders, one for each column (9) of the second grid (13B) of compartments, and collecting the separated plant sections in the second grid of compartments column by column in a respective plant section holder such that the plant sections from each column are stored together in the respective plant section holder of that column.

14. Method according to claim 13, wherein the separated plant sections of the third grid (13C) of compartments are stored individually, for later use of the separated plant sections.

15. Method of claim 1, wherein the device comprises:

- a first series of compartments (5) in the form of slots (50) extending in a first slot direction, the first series of slots being arranged above the plant grid,
 - a second series (52) of compartments (5) in the form of slots extending in a second slot direction which is different from the first slot direction, the second series of slots being provided below the first series of slots, wherein in top view the first and second series of slots define the openings (59) which are arranged in a grid,
 - a first cutting plate (14A) arranged below the first series of slots, the first cutting plate being constructed to move in a first cutting direction (31) which is different from the first slot direction,
 - a second cutting plate (14B) arranged below the second series of slots, the second cutting plate being constructed to move in a second cutting direction (32) which is different from the second slot direction,
- the method comprising:
- providing the plant through the openings, such that only one plant extends through each opening, and such that a first section (1A) of each plant extends in a slot (51) of the first series (50) of slots and a second section (1B) extends in a slot (53) of the second series (52) of slots,
 - cutting the plants with the first cutting plate (14A) by moving the first cutting plate along the underside of the first series of slots in the first cutting direction (31)
 - cutting the plants with the second cutting plate (14B) by moving the second cutting plate along the underside of the second series of slots in the second cutting direction (32) , such that multiple plant sections remain behind in each slot of the first series of slots and multiple plant sections remain behind in each slot of the second series of slots, and
 - collecting the plant sections from the respective slots for later use as samples.
16. Method according to any of claims 1 - 15, wherein after the cutting and prior to the collecting, the cut plant sections in at least one grid of compartments remain confined within boundaries of the respective compartments.
17. Device for taking samples from a plurality of plants, the device comprising:
- a plant support (4) for supporting a plurality of plants (1) arranged in a grid (23),

- a plurality of compartments (5) arranged (13) above or below the plant support, wherein the plurality of compartments – in top view – define openings (59) which are arranged in a grid,
- a cutting device (8) constructed for cutting plant sections from plants which extend upwardly or downwardly from the plant support through the openings.

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18. Device according to claim 17, comprising:

- a plurality of compartments (5) arranged in at least one grid of compartments (13) above or below the plant support, wherein the compartments define the openings,
- a cutting device (8) constructed for cutting plant sections from plants which extend upwardly or downwardly from the plant support into the compartments.

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19. Device according to claim 17 or 18, comprising:

- at least a first grid of compartments (13A),
- at least a second grid of compartments (13B),

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wherein each compartment (5A) of the first grid of compartments is associated with a compartment (5B) of the second grid of compartments, and wherein the first and second grids of compartments are configured such that in use a plant extends through both grids of compartments such that a first section (1A) of each plant (1) extends in a compartment of the first grid of compartments and a second section (1B) of that plant (1) extends in the associated compartment (5B) of the second grid of compartments, and wherein the cutting device is configured for cutting the plants such that for each plant the first plant section in the compartment of the first grid of compartments and the second plant section in the compartment of the second grid of compartments become separated from the plant.

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20. Device according to claim 19, wherein the first grid of compartments and the second grid of compartments are constructed to be placed above one another.

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21. Device according to claim 19 or 20 comprising a third grid (13C) of compartments, wherein each compartment (5C) of the third grid of compartments is associated with a compartment of the second grid of compartments and with a compartment of the first grid of compartments.

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22. Device according to any of claims 17 - 21, wherein the plurality of compartments are provided as a plurality of cavities in a compartment tray (6A, 6B, 6C;56,58).

23. Device according to any of claims 17 - 22, wherein the at least first and second grid of compartments are moveable relative to one another, wherein each compartment of the first grid of compartments comprises at least one cutting edge (8) at a lower end (21) of said compartment, the cutting edge being configured to cooperate with a cutting edge (8) of an associated compartment in the second grid of compartments for separating the plant section in the compartment from the plant during the moving of the first grid relative to the second grid.
24. Device according to any of claims 17 - 23, wherein the cutting device comprises at least one plate (14A, 14B, 14C, 14D) with at least one cutting edge, the plate being movable relative to a grid of compartments along bottom ends of the respective compartments of said grid of compartments.
25. Device according to claim 24, wherein the at least one plate is movable between the first grid of compartments (13A) and the second grid of compartments (13B).
26. Device according to claim 24 or 25, comprising multiple plates (14A, 14B, 14C, 14D) with a cutting edge, each plate being associated with a grid of compartments.
27. Device according to any of claims 17 - 26, wherein the compartments are removable from the device (10) in order to collect the plant sections from the compartments.
28. Device according to any of claims 17-27, wherein:
- a first series (50) compartments (5) in the form of slots (51) extending in a first slot direction, the first series of slots being arranged above or below the plant grid,
 - a second series (52) of compartments (5) in the form of slots (53) extending in a second slot direction which is different from the first slot direction, the second series of slots being provided below the first series of slots, wherein in top view the first and second series of slots define openings arranged in a grid,
 - a first cutting plate (14A) arranged below the first series of slots, the first cutting plate being constructed to move in a first cutting direction (31) which is different from the first slot direction

- a second cutting plate (14B) arranged below the second series of slots, the second cutting plate being constructed to move in a second cutting direction (32) which is different from the second slot direction.

- 5 29. Device according to any of claims 17 - 28, wherein at least one grid of compartments and the cutting device are arranged such that after the cutting and prior to the collecting of the cut plant sections, the cut plant sections in at least one grid of compartments remain confined within boundaries of the respective compartments.

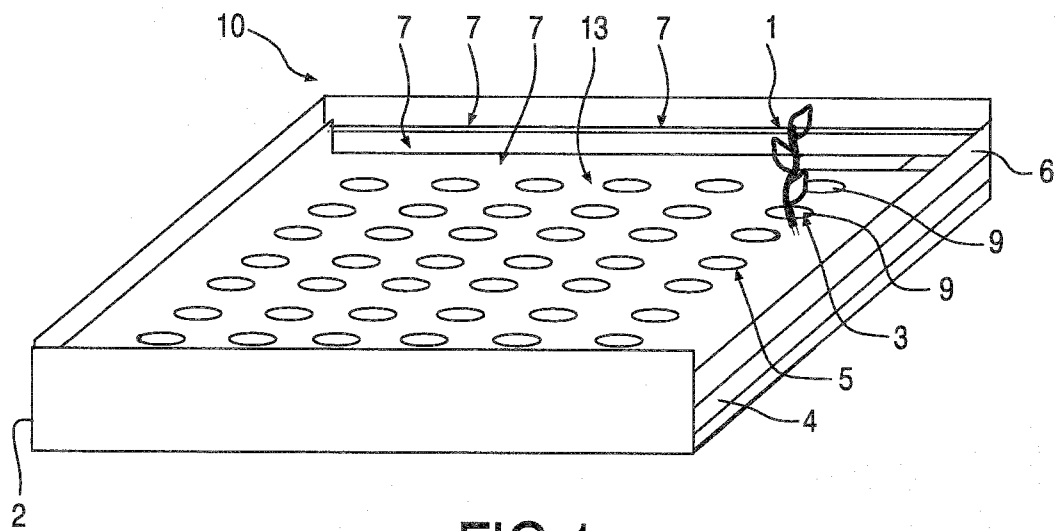


FIG.1

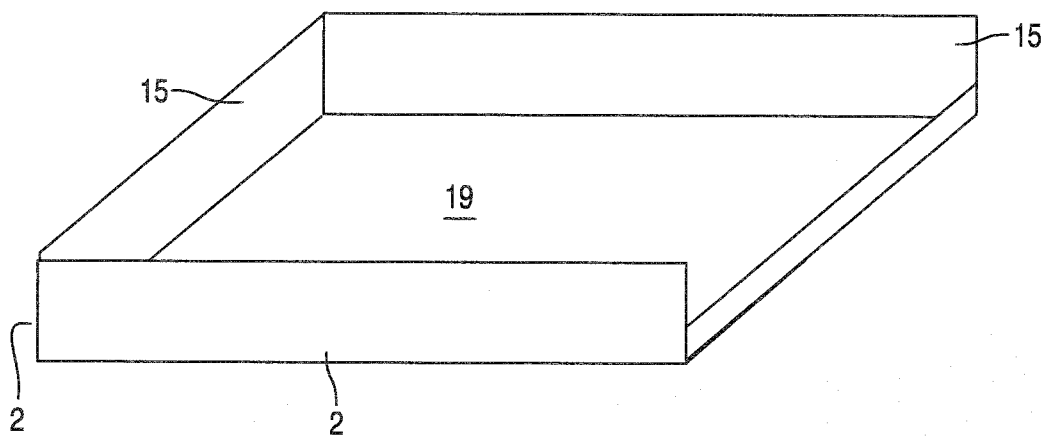
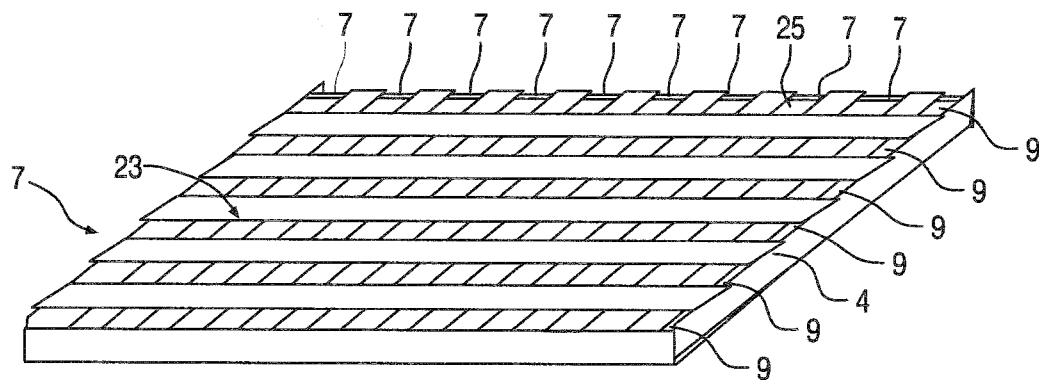


FIG.2

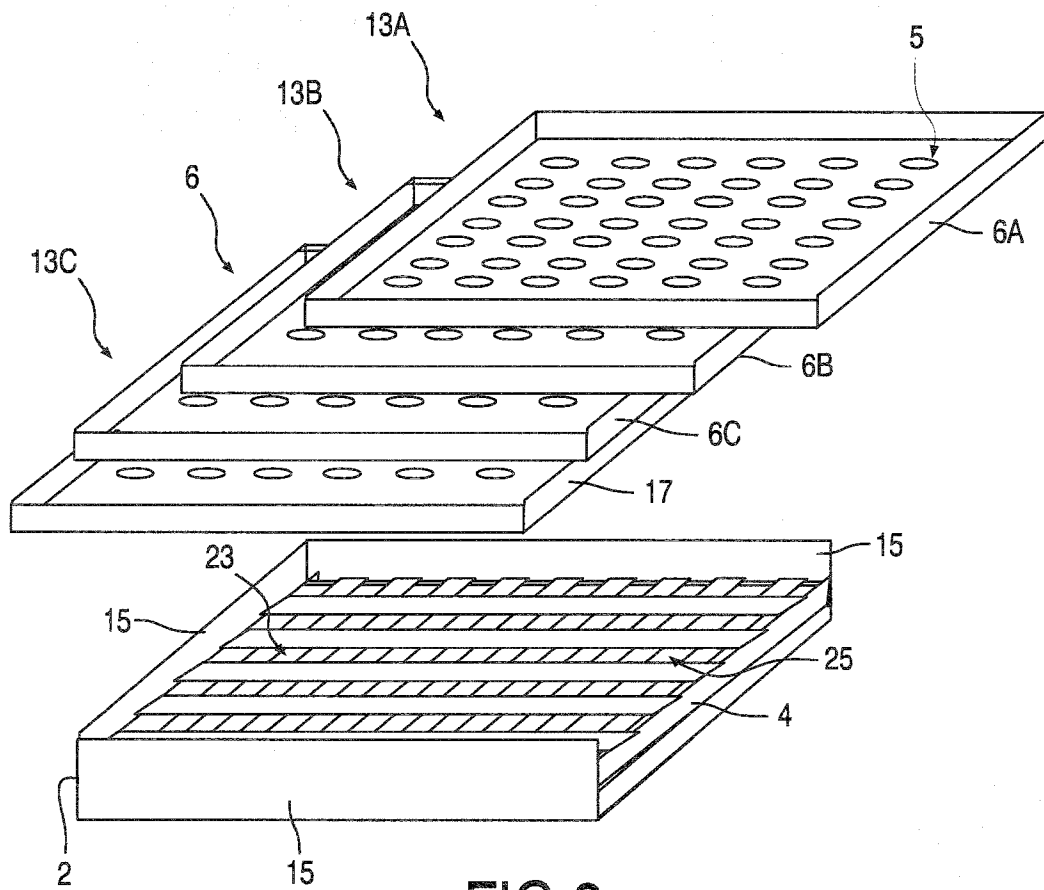


FIG. 3

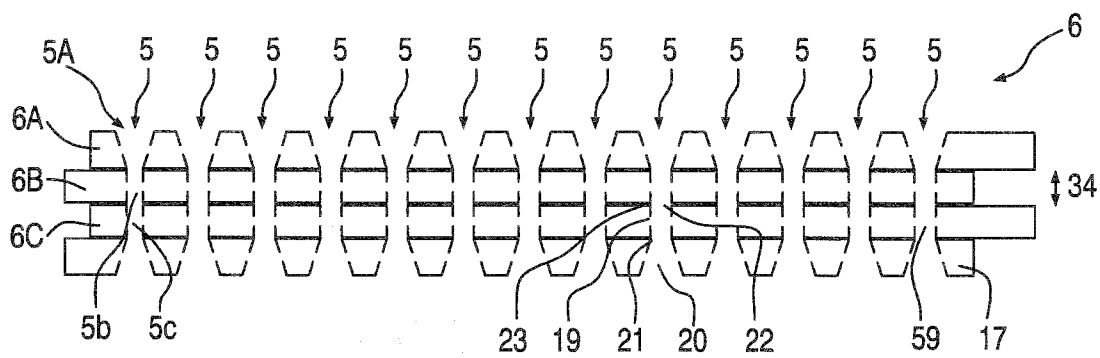


FIG. 4

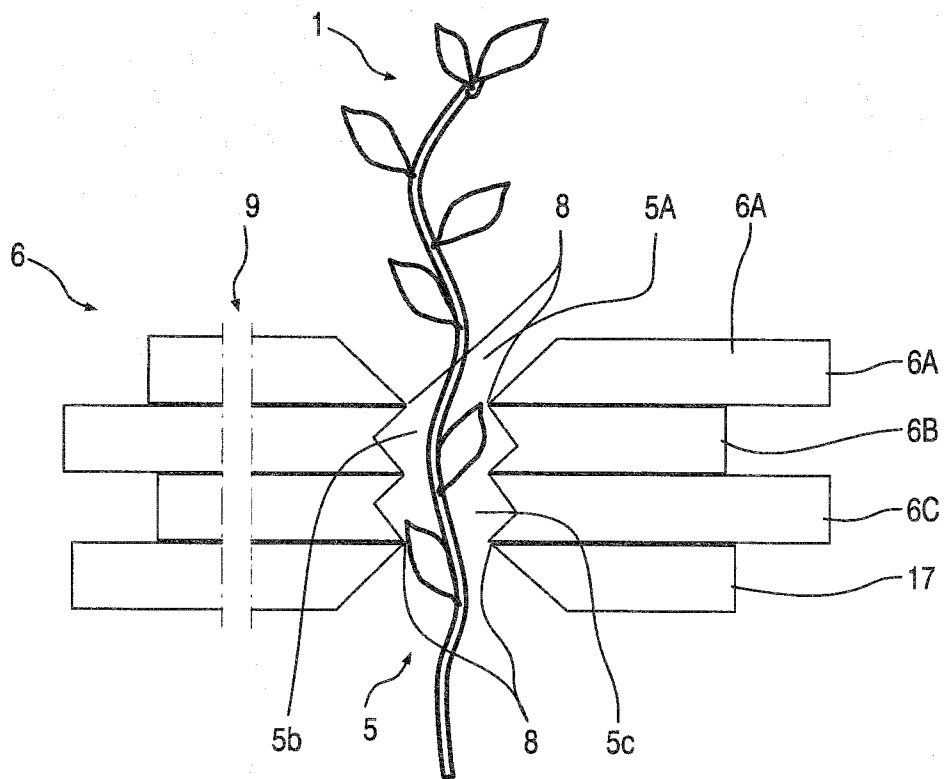


FIG.5

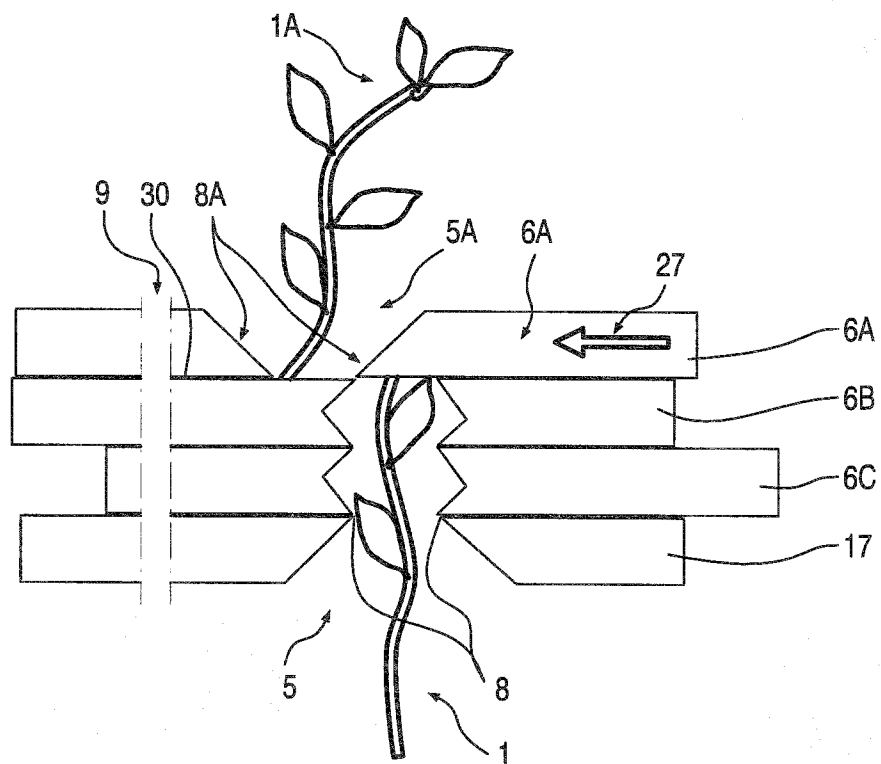


FIG.6

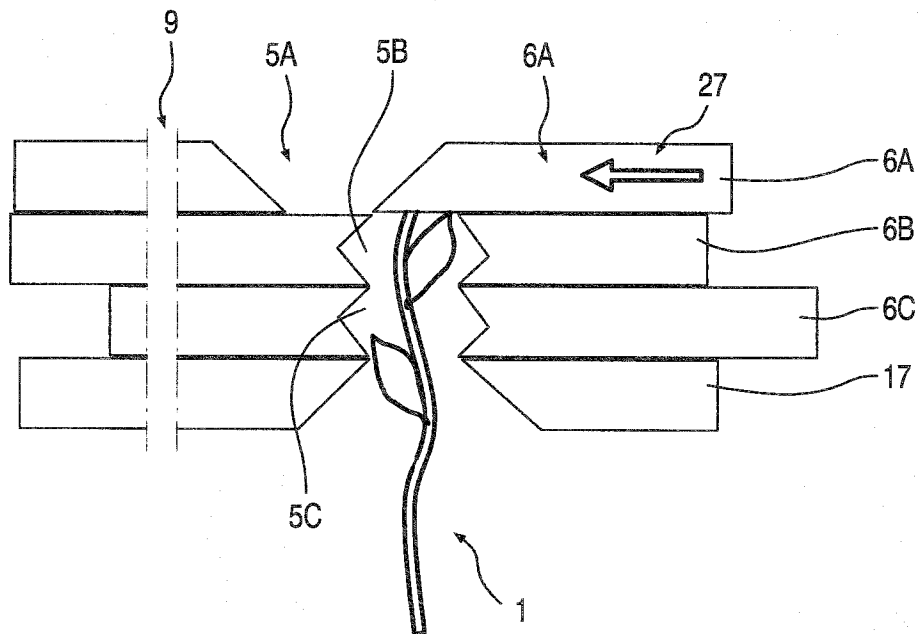


FIG. 7

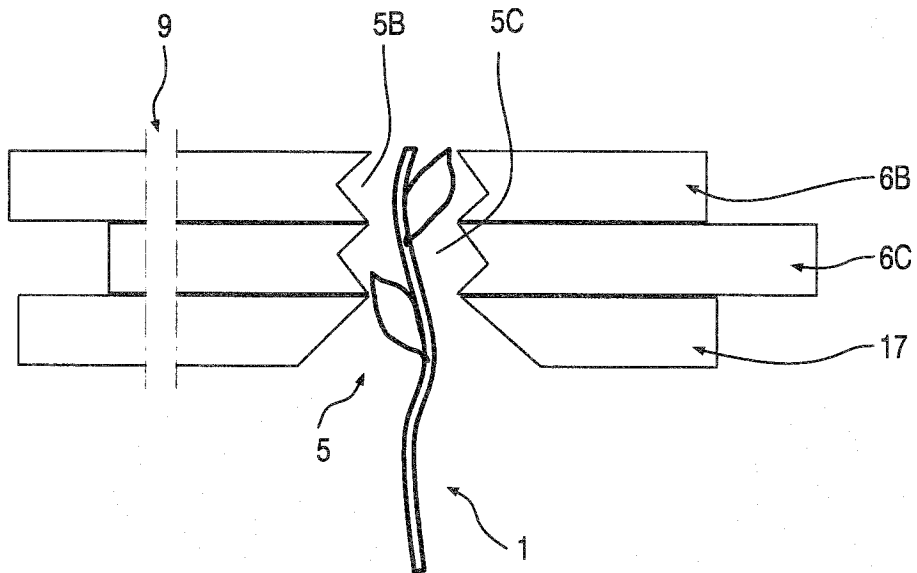


FIG. 8

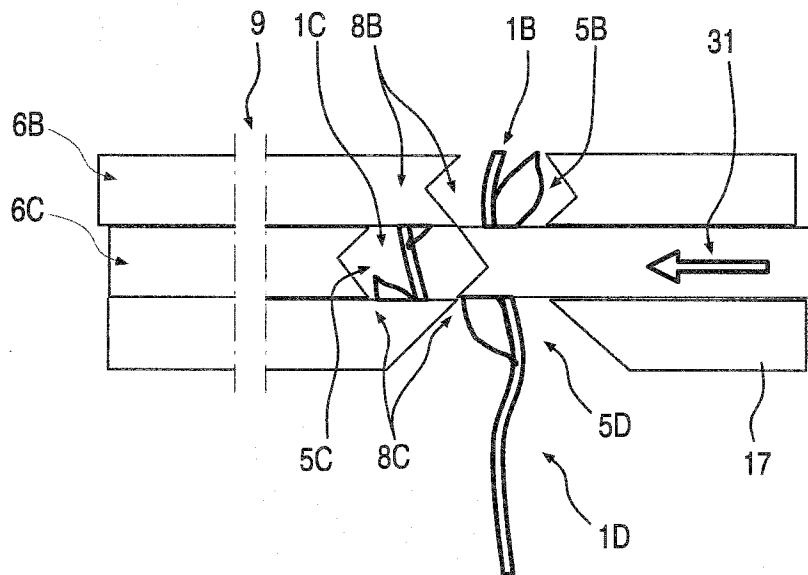


FIG. 9

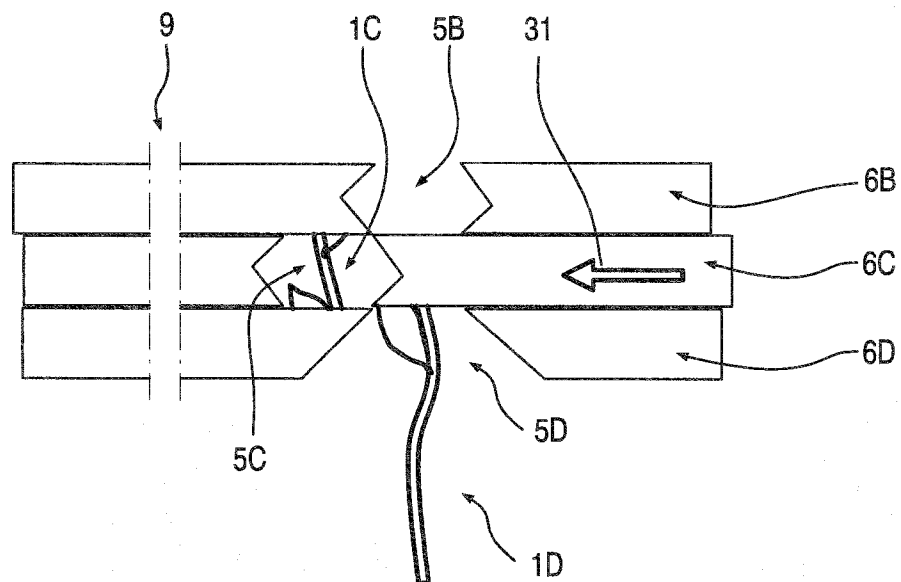
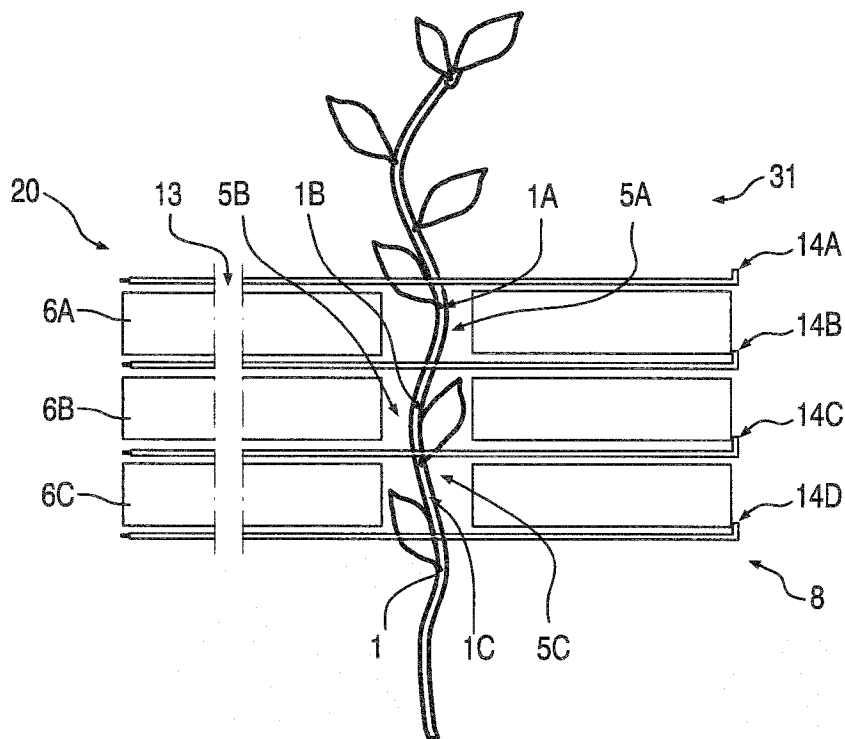
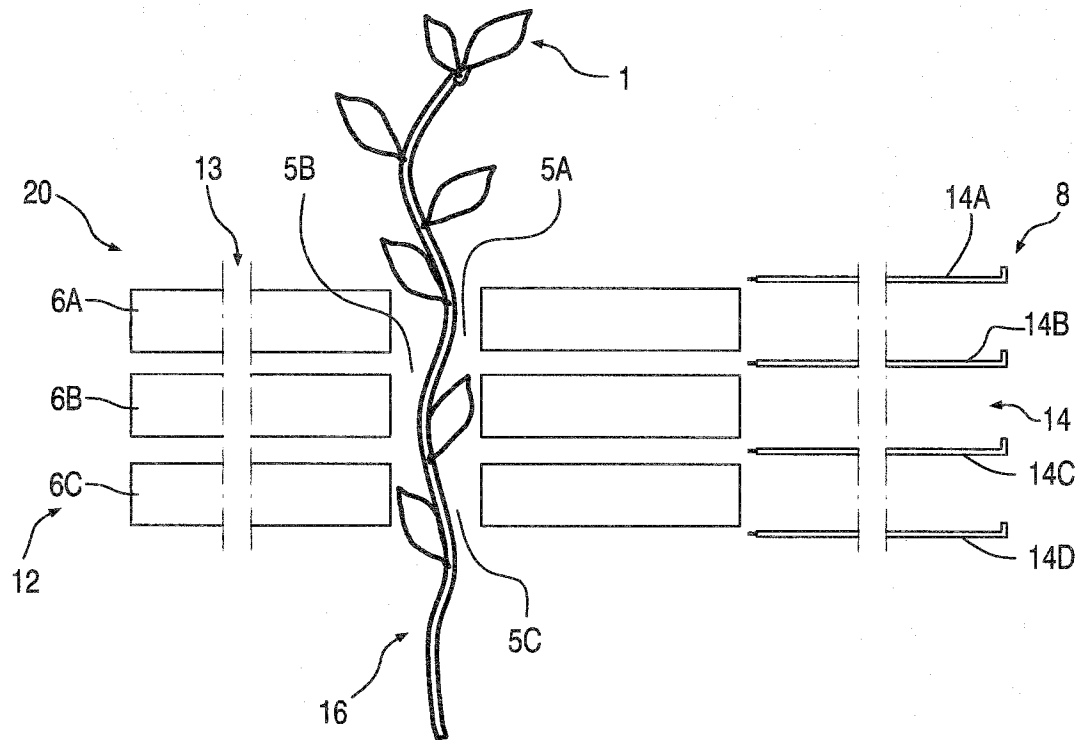


FIG. 10



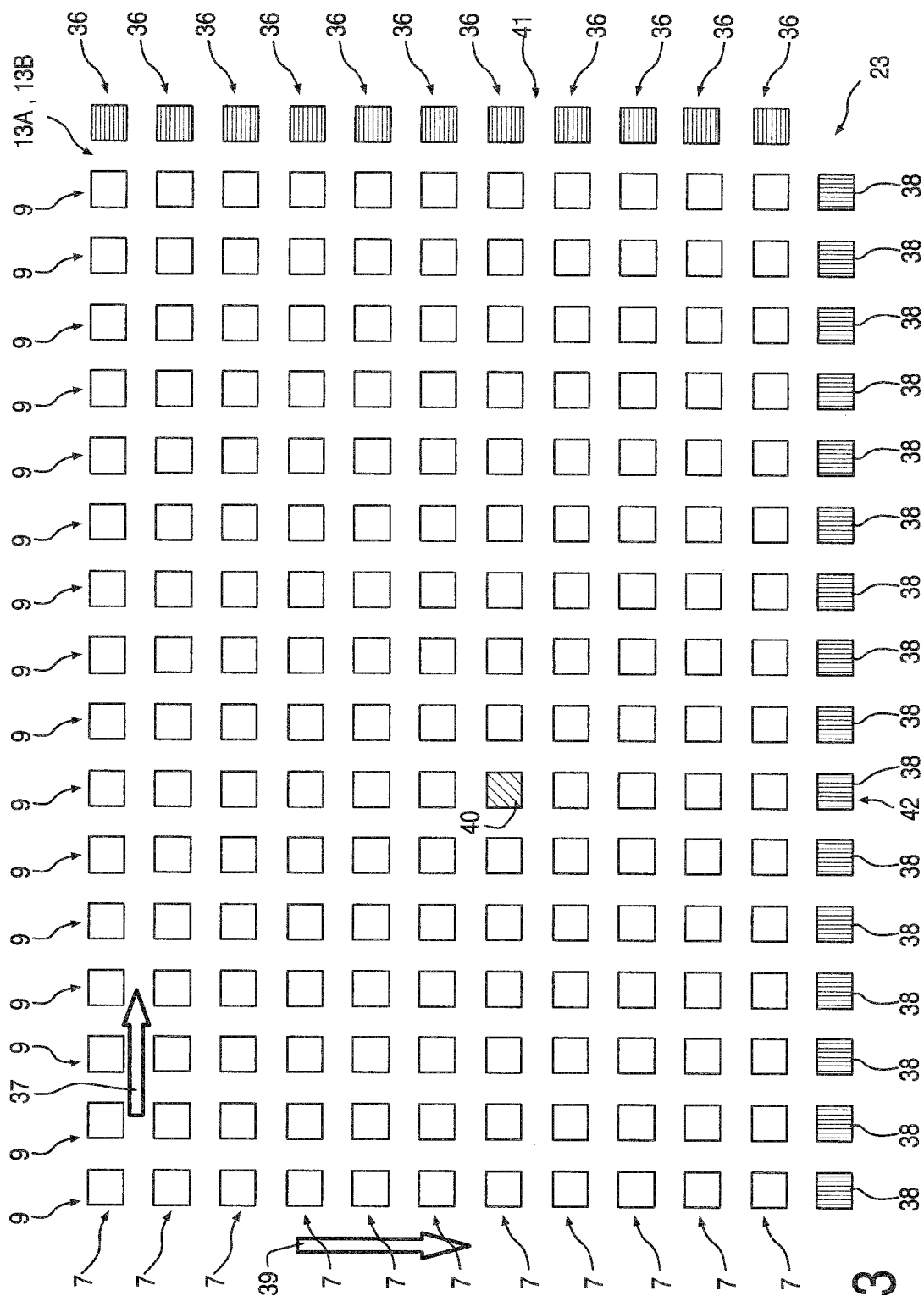


FIG.13

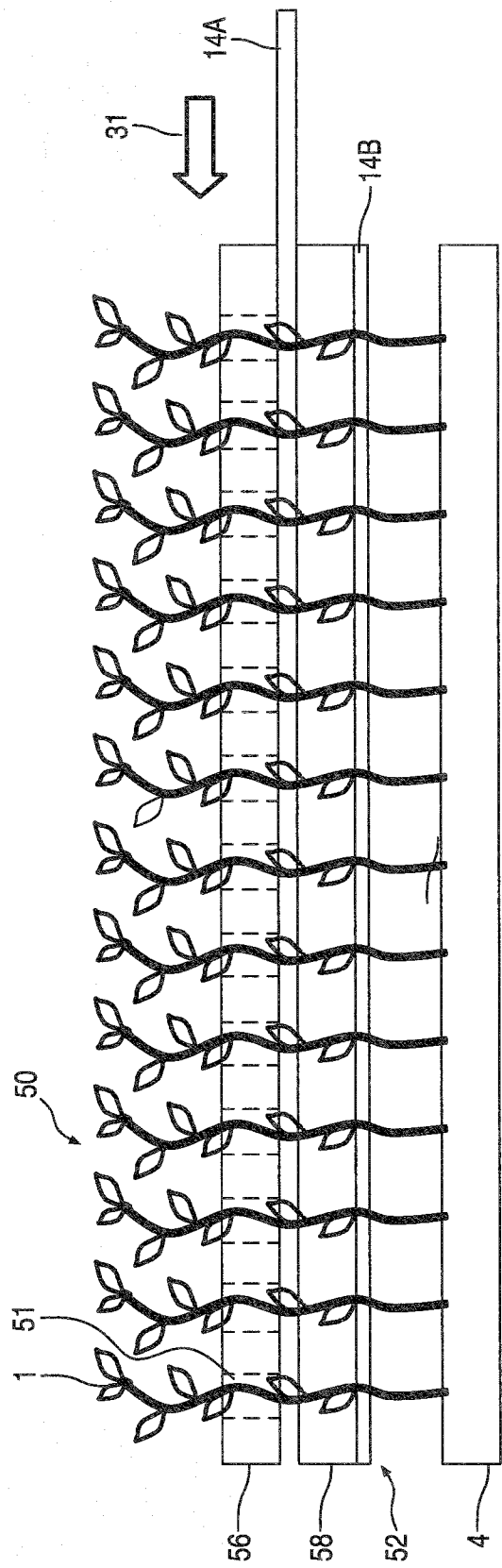


FIG.14

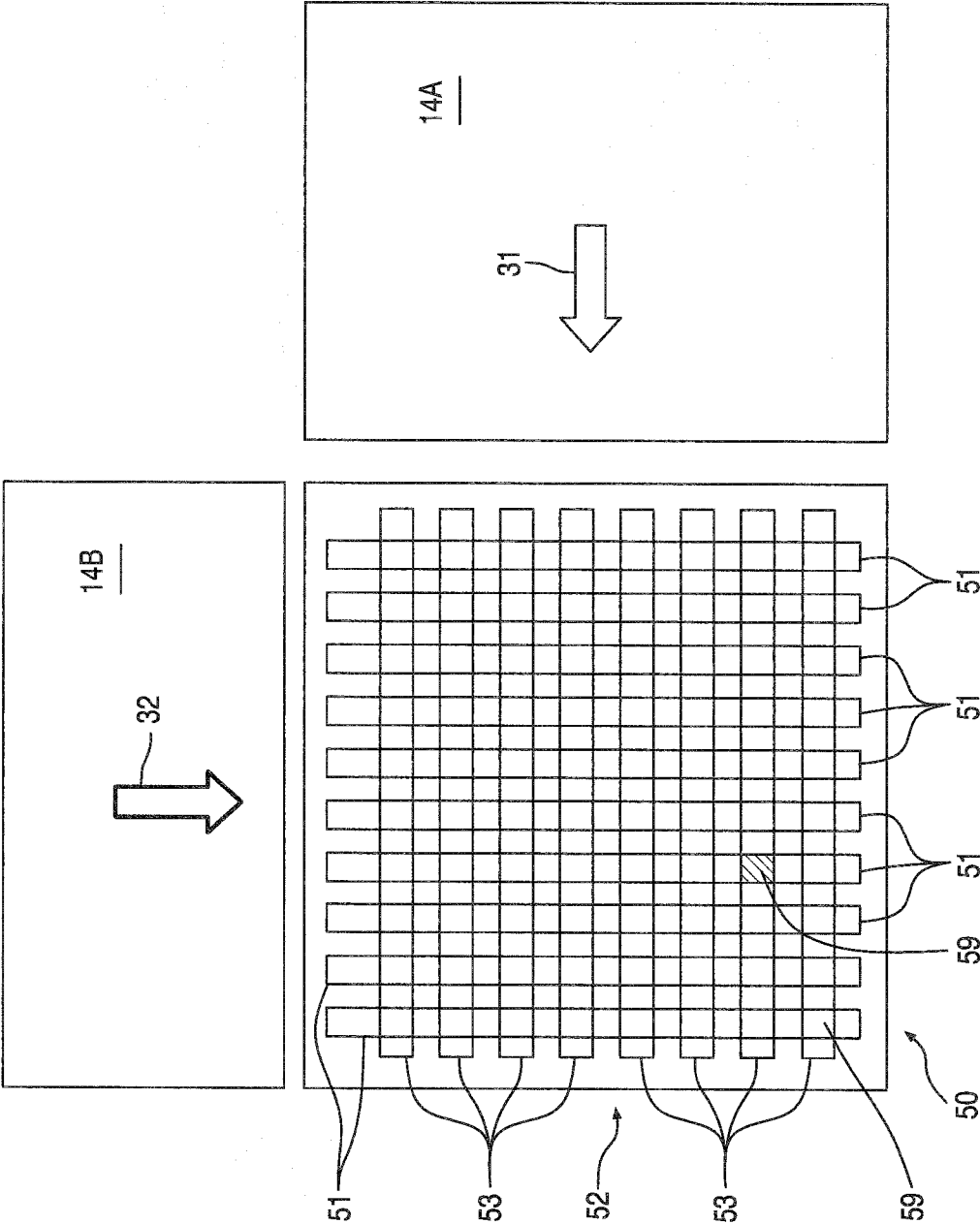


FIG.15

INTERNATIONAL SEARCH REPORT

International application No

PCT/NL2011/050897

A. CLASSIFICATION OF SUBJECT MATTER

INV. A01G7/00
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 A01H

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

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

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 5 370 713 A (HANSELER KURT [AU]) 6 December 1994 (1994-12-06) column 4, line 4 - line 41; figures 1-4 -----	1,2,17, 18,22
A	US 2006/112619 A1 (ODERWALD MICHIEL P [NL] ET AL ODERWALD MICHIEL PETER [NL] ET AL) 1 June 2006 (2006-06-01) cited in the application abstract; figures -----	1,17



Further documents are listed in the continuation of Box C.



See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search

23 April 2012

Date of mailing of the international search report

08/05/2012

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Authorized officer

Merckx, Alain

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

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