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(54) **Harvesting device**

(57) The present invention relates to a harvesting device for harvesting horticultural produce, from plant stems in greenhouse cultivation, the device comprising a guiding member, which defines a through plant passage and which is configured to surround the plant stem at least partially in the plant passage during use, and a cutting member, which is attached to the guiding member and which is configured to cut peduncles of the produce that is attached to the plant stems, to separate them from the plant stems.

The plant stems are configured to be guided inside the guiding member upon relative movements of the harvesting device along the plant stem along a longitudinal axis and the cutting member is configured to cut the peduncles that pass the guiding member during movement of the harvesting device.

The harvesting device further comprises a storage member, which surrounds the guiding member at least partially and which is configured to collect the produce that is separated from the plant stems and preferably configured to drop off the side shoots and leaves.

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Title: Harvesting device

Field of the invention

The present invention relates to a harvesting for harvesting horticultural produce, side shoots and/or leaves from plant stems in greenhouse cultivation. The present invention further relates to a harvesting apparatus and to a method of horticultural produce, side shoots and/or leaves from plant stems in greenhouse cultivation.

State of the art

At present, various types of harvesting apparatuses are known for use in greenhouse cultivation. A first example thereof is the so-called Sweeper harvesting robot developed, amongst others, by Wageningen University and Research (NL). This robot comprises a harvesting device attached to a manipulator arm, configured to move the harvesting device to horticultural produce, i.e. bell peppers, on the basis of a sensor signal and wherein the harvesting device is configured to cut the produce from the plant and to transport it to a storage by means of the manipulator arm.

This Sweeper robot has the drawback that it first needs to find the stem of the plant with its sensors, then needs to follow the stem by means of the sensors to find any ripe produce. After harvesting, the harvesting device needs to catch the produce that was cut and needs to move it towards a storage by means of the manipulator arm. This all has the drawback that the Sweeper robot is relatively slow in operation.

Another example of a cutting apparatus is known from Dutch Patent NL1024702C2, which discloses a manipulator arm and a cutting device that surrounds the plant stem and that is configured to be moved along the plant stem. This cutting device is able to cut leaves and side shoots of the plants, but is unable to harvest produce from the plant. Hence, cut parts of the plants, i.e. the leaves and the side shoots, merely fall on the greenhouse floor. In case produce is cut, this system comprises no means to process the produce that was cut, for example for packaging and/or further processing.

Object of the invention

It is therefore an object of the invention to provide a harvesting device that is able to harvest horticultural produce is a more efficient manner, or at least to provide an alternative harvesting device.

Detailed description

The present invention provides a harvesting device for harvesting horticultural produce, side shoots and/or leaves from plant stems in greenhouse cultivation, the device comprising:

- a guiding member, which defines a through plant passage and which is configured to surround the plant stem at least partially in the plant passage during use, and
- a cutting member, which is attached to the guiding member and which is configured to cut peduncles of the produce, the side shoots and/or petioles of the leaves that are attached to the plant stems, to separate them from the plant stems,

wherein the plant stems are configured to be guided inside the guiding member upon relative movements of the harvesting device along the plant stem along a longitudinal axis, i.e. in an upward vertical direction, and wherein the cutting member is configured to cut the peduncles, the side shoots and/or the petioles that pass the guiding member during movement of the harvesting device, characterized in that the harvesting device further comprises:

- a storage member, which surrounds the guiding member at least partially and which is configured to collect the produce that is separated from the plant stems and preferably configured to drop off the side shoots and leaves.

The harvesting device according to the present invention is configured to be moved along the plant stem, during which the plant stem is substantially enclosed in the through plant passage. With substantially enclosed, it is meant that the plant stem may be either completely surrounded by the guiding member or that it may be surrounded partly by the guiding member.

The harvesting device is configured to receive the plant stem inside the plant passage of the guiding member. The passage extends along the longitudinal axis, so that the plant stem extends along the longitudinal axis as well. The longitudinal axis may be aligned substantially vertically and upward, but may also have a component in a horizontal direction, for example being aligned at an angle between 0° and 20° with respect to an upward vertical direction.

The harvesting device is configured to be guided with respect to the plant stem as a result of the plant stem being received in, i.e. at least partly surrounded by the through plant passage in the guiding member.

With being guided, it is meant that either the harvesting device is moved with respect to its surroundings and that the plant stem follows the movement of the guiding member, for example that the harvesting device is moved upward, for example along the longitudinal axis, and that the plant is moved sideways as the result of its guidance in the through plant passage. Additionally, the harvesting device may also be actively moved in directions having

at least a component perpendicular to longitudinal axis, so that the harvesting device can actively follow any bends or curves in the plant stem.

Alternatively, it is meant with being guided that the harvesting device is held substantially stationary and that the plant is displaced in the through plant passage, for example being raised or lowered therein. For example, the harvesting device may be held stationary in directions parallel to the longitudinal axis, but may optionally be actively moved in directions having at least a component perpendicular to longitudinal axis, so that the harvesting device can actively follow any bends or curves in the plant stem.

The cutting member of the harvesting device is attached to the guiding member and is thus also configured to be moved relative to the plant stem in conjunction with the guiding member. The cutting member may be provided to at least partly surround the through plant passage in a way similar to the surrounding of the guiding member.

Upon relative movement between the plant stem and the harvesting device, e.g. movement of the harvesting device along the plant stem, the harvesting device may encounter horticultural produce, such as tomatoes, for example vine tomatoes, bell peppers, eggplants and cucumbers that are attached to the plant stem by means of peduncles. Similarly, the plant stem may have undesired side shoots attached to it and may have leaves attached to it by means of petioles, e.g. for example three leaves in between each vine of tomatoes, that both need to be removed during growth of the plant.

The cutting member is configured to cut-off all of these peduncles, side shoots and petioles that come to face the cutting member when the harvesting device is moved with respect to the plant stem, e.g. to perform a so-called stripping action onto the plant stem. The peduncles, side shoots and petioles sidewardly project away from the plant stem, for example horizontally away from the plant stem, so that they are disposed wider than the plant stem itself.

The cutting member may be spaced at a distance from the through plant passage in the guiding member, to avoid that the plant stem itself is being cut, but that, instead, only the outwardly-protruding peduncles, side shoots and petioles are cut. However, the cutting member is on the other hand configured to make the cuts as close to the plant stem as possible, so that any remaining stub on the plant stem after cutting is as short as possible.

The harvesting device according to the present invention additionally comprises the storage member, which forms part of the harvesting device, to be moved with respect to the plant stem. The storage member surrounds the guiding member, for example in a way similar the guiding member surrounds the through plant passage. The storage member may be arranged to substantially enclose the plant stem, which means that the plant stem may be either completely surrounded by the storage member or that it may be surrounded partly by the storage member.

The storage member projects away from the guiding member and the cutting member in directions radial to the longitudinal axis. In this way, it is affected that the storage member may have a larger contour or footprint than the guiding member and the cutting member. This larger contour ensures that the storage member project underneath the horticultural produce, which produce is located radially outside the cutting member. After cutting, the horticultural produce can then be caught on the storage member to prevent it from falling on the ground and to prevent grabbing of the produce, prior to cutting, and actively removal of the produce, after cutting, as was required according to the prior art.

The storage member is configured to autonomously collect the horticultural produce that has been cut off from the plant stem by the cutting member, e.g. without requiring active steps in terms of movement of the storage member towards the produce. The storage member may thereto be located underneath the cutting member, so that the produce may drop onto the storage member after cutting under the influence of gravitational forces acting onto the produce. The storage member is preferably located underneath the entire cutting member, so that all produce, e.g. irrespective of with which part of the cutting member is was cut off, will become collected on the storage member.

The storage member is preferably configured to drop off the side shoots and leaves, since these are not desired to be stored. Instead, side shoots and leaves are undesired side products without significant value, which not need to be maintained, but which are cut by the cutting member after all. The side shoots and leaves may have geometries, sizes and/or weight that differ from that of the produce, which implies that the storage member may be dimensioned, such that only the produce is collected thereon and that the side shoots and leaves can drop off.

As an example, tomato leaves have a somewhat triangular shape with a size of approximately 50 centimetres, whereas a vine of tomatoes is approximately elongate with a length of 20 centimetres and a weight that is approximately 10 times higher. The storage member may thereto have a width of approximately 20 centimetres, so that the centre of gravity of the vine of tomatoes falls within the contour of the storage member, whereas the centre of gravity of the leave falls outside the contour of the storage member, so that the leave will tilt over the outer edge of the storage member after having dropped thereon and that the leaves will fall from the storage member accordingly.

In an embodiment, the storage member is rotatable relative to the guiding member and/or the cutting member about the longitudinal axis. This rotation may effect that after produce has been collect on the storage member in a specific location, the storage member can be rotated so that a new and non-occupied part of the storage member comes to face the part of the guiding member and/or the cutting member where subsequent produce is to be cut

and collected. In this way, multiple cutting steps can be undertaken subsequently without requiring emptying of the storage member in between each two subsequent cutting steps.

The rotation of the storage member relative to the guiding member and/or the cutting member may be facilitated by a bearing, such as an annular bearing provided in between the guiding member and the storage member and/or between the cutting member and the storage member. An electric motor may be provided to actively actuate the rotation.

In an embodiment, the harvesting further comprises a rocking mechanism, which is configured to tilt the harvesting device with respect to a horizontal tilting axis. The tilting may contribute in the guiding of the peduncles, side shoots and petioles of the plant towards the cutting member. As a result of these protruding outwardly from the plant stem, that may undesirably become jammed against the guiding member. By rocking the harvesting device, this jamming may be abolished and the peduncles, side shoots and petioles can be further guided towards the cutting member.

The rocking mechanism may be carried out with respect to a fixed reference, for example with respect to an actuator or a manipulator arm to which the harvesting device is attached for performing the movement along the longitudinal axis along the plant stem. The horizontal tilting axis may be aligned perpendicular to the longitudinal axis and the rocking may be superimposed with the rotation of the storage member, so that the storage member can both be tilted and rotated with respect to the fixed reference.

In an embodiment, the guiding member, the cutting member and the storage member are together, seen in a plane perpendicular to the longitudinal axis, subdivided in:

- a first device part, comprising a first guiding member part, a first cutting member part and a first storage member part, and in
- a second device part, comprising a second guiding member part, a second cutting member part and a second storage member part,

wherein the first device part and the second device can be moved away from each other in an opened configuration to allow entry in and exit from the plant stem in the plant passage in a radial direction perpendicular to the longitudinal axis, and wherein the first device part and the second device can be moved towards each other in a closed configuration to fully enclose the plant passage, i.e. to fully surround the plant stem.

The separation of the harvesting device in the first device part and the second device part is preferably done in one or more planes parallel to the longitudinal axis, so that the separation between the parts is visible in the plane perpendicular to the longitudinal axis, for example when looking downward onto the harvesting device.

The first device part may be an integral part of the first guiding member part, the first cutting member part and the first storage member part and the second device part may be an integral part of the second guiding member part, the second cutting member part and the second storage member part, so that the integral first device part is entirely separable from and movable relative to the integral second device part.

By having the harvesting device split in the first device part and second device part, the through plant passage in the guiding member may be surrounded entirely and fully enclosed by the harvesting device during use, e.g. in the closed configuration. During use, the first device part and the second device part may thereto be arranged against each other to fully enclose the plant stem.

In case it is desired to remove a plant stem from the plant passage, for example when the cutting has taken place to a desired extent, or to insert a new plant stem in the plant passage, the first device part and the second device part are brought in the opened configuration. In the opened configuration, the device parts can be moved away from each other at least partly, so that axis is provided towards the plant passage from the side. Accordingly, the plant passage is no longer fully enclosed, but instead allows for entry and exit of plant stems in the plant passage from the side, e.g. perpendicular to the longitudinal axis.

In the absence of a first device part and a second device part, in alternative embodiments, the through plant passage may either be not fully enclosed so that entry and exit of plant stems in the plant passage is possible all the time, or the through plant passage may be fully enclosed so that entry and exit of plant stems in the plant passage is only possible at the head ends thereof, e.g. along the longitudinal axis.

In a further embodiment, the first device part and the second device part are, upon movement between the opened configuration and the closed configuration:

- rotatable relative to each other about an axis of rotation parallel to the longitudinal axis, and/or
- displaceable relative to each other in a displacement direction perpendicular to the longitudinal axis.

The device parts may be attached to each other by means of a hinge to allow the relative rotation between them. The hinge may form the sole connection between the device parts in the opened configuration, in which the device parts have rotated away from each other about the axis of rotation, e.g. a substantially vertical axis of rotation. When the device parts are moved into the closed configuration, the device parts are rotated towards each other, so that they also come to abut each other opposite to the hinge.

Alternatively or additionally, the device parts can be displaced with respect to each other, for example by means of a linear actuator. As such, the device parts may be set at a distance from each other in the opened configuration and may abut each other in the closed configuration.

In an alternative embodiment, the harvesting device further comprises a side aperture, which provides access to the plant passage in an access direction substantially perpendicular to the longitudinal axis to allow entry in and exit from the plant stem in the plant passage in the access direction. According this embodiment, the guiding member, the cutting member and the storage member form a unitary harvesting device. The side opening is provided to allow access towards the plant passage from the side, to allow for entry and exit of plant stems in the plant passage.

In an embodiment, the storage member comprising a skirt surface, e.g. an at least partially cone-shaped skirt surface, which tapers outwardly in the radial direction upon increasing distance from the cutting member, i.e. in a downward vertical direction. The skirt surface surrounds the guiding member and the cutting member and forms a support surface for the produce to land on after cutting and to be collected for further handling.

The skirt surface tapers outward from the guiding member and also slopes downward, i.e. having a planar component in the downward vertical direction. For embodiments with a circular plant passage, e.g. having a circular cross-section perpendicular to the longitudinal axis, the skirt surface may have a circular outer contour shape, effectively causing the skirt surface to be cone shaped.

The storage member may further comprise delimiting means, located at the lowermost edge, e.g. the lowermost circumferential edge of the skirt surface, which is configured to prevent the produce from falling off the skirt surface at the bottom. The delimiting means may for example comprise a circumferential ridge at the bottom edge of the skirt surface.

In a further embodiment, the skirt surface is set at a skirt angle with respect to the longitudinal axis, and the skirt angle is preferably selected in the range between 30° and 60°.

The skirt angle of the skirt surface is defined as the angle between the plane of the skirt surface and the longitudinal axis. The skirt angle can be varied to alter the steepness of the skirt surface and therefor changes the properties of the storage member, for example in terms of which cut part, e.g. produce, side shoot or leaf, remains resting on the skirt surface and which will fall off.

The skirt angle may be selected to optimally support the produce after cutting and to avoid the produce from falling onto the skirt surface, or from being damaged after cutting in

general. Furthermore, the selection of the skirt angle may be selected such that only the produce itself will be supported by the skirt surface prior to cutting and during the upward movement of the harvesting device, but that it is prevented that the entire plant stem is lifted when the produce remains connected to the plant stem.

The skirt angle may be selected in dependence of the type of produce that is to be harvested, so that the skirt surface may be aligned substantially parallel to an elongate direction in which the produce substantially extends. For example, cucumbers hang almost vertically from the plant stem, which implies that the skirt angle can be selected relatively small if the harvesting device is to be used for harvesting cucumbers. However, vine tomatoes grow more horizontally than cucumbers, which implies that the skirt angle can be selected larger in case the harvesting device is used for harvesting tomatoes.

In a way similar to the selection of the skirt angle, may the height of the skirt surface be selected on the basis of the length of the produce that is to be harvested. If, for example, the harvesting device is used for harvesting cucumbers, the height can be selected larger than when the harvesting device is used to harvest bell peppers, which are typically shorter than cucumbers.

In a further embodiment, the skirt surface comprises:

- a first skirt section, which is attached to the guiding member, e.g. located below the guiding member, and
- a second skirt section, which is attached to the first skirt section at a side opposite to the guiding member, e.g. located below the first skirt section,

wherein the first skirt section is set at a first skirt angle and wherein the second skirt section is set at a second skirt angle, and wherein the second skirt angle is larger than the first skirt angle.

According to this embodiment, the skirt surface is subdivided in two sections, which each have a different functionality. The first skirt section is located directly below the guiding member and forms an initial support for the produce, prior to being cut by the cutting device. Upon further upward movement of the harvesting device, the produce is cut and the produce is allowed to slide down onto the second skirt section, which is located directly below the first skirt section. The second skirt section is aligned more horizontally than the first skirt section, e.g. having a large skirt angle than the first skirt section, to that the cut produce will slow down after sliding from the first skirt section and that the produce is collected on the second skirt section.

The first skirt section and the second skirt section are preferably attached to each other by means of a smooth transition, in order to avoid unnecessary damaging of the produce during their slide from the first skirt section to the second skirt section.

In an embodiment, the cutting member is, seen in the radial direction, spaced at a distance from the plant passage, and the distance is preferably selected in the range between 5 mm and 15 mm.

The spacing between the plant passage, e.g. being delimited by the guiding member, and the cutting member provides that the plant stem can never be in direct contact with the cutting member, because the plant stem would always contact the guiding member before contacting the cutting member. Instead, the distance between the plant passage The cutting member may be spaced at a distance from the through plant passage in the guiding member, to avoid that the plant stem itself is being cut, but that, instead, only the outwardly-protruding peduncles, side shoots and petioles are cut. By selecting the distance appropriately, for example in the range between 5 mm and 15 mm, it may be provided that the cutting member is configured to make the cuts as close to the plant stem as possible, so that any remaining stub on the plant stem after cutting is as short as possible.

In an embodiment, the guiding member is crown-shaped, comprising:

- a plurality of tips, which are aligned upwardly and substantially parallel to the longitudinal axis and which are spaced around the circumference of the plant passage, and
- a respective tapered guiding valley in between each two adjacent tips.

The crown-shape is configured to effect sideways guiding of the peduncles, side shoots and petioles as a result of the tapered guiding valleys in between each two adjacent tips. Hence, in principle, peduncles, side shoots and petiole could be arranged around the entire circumference of the plant stem. With the crown-shape, the peduncles, side shoots and petioles are guided to certain discrete locations in the valleys, where the cutting member is provided. As a result, the cutting member does not need to be arranged around the entire circumference of the plant passage, but instead only at the location to which the peduncles, side shoots and petioles are guided

If, during use of the harvesting device, the peduncles, side shoots and petioles are already located in a valley during movement of the harvesting device, they may converge towards the bottom of the valley. If the peduncles, side shoots and petioles end up on top of the tips, the rocking mechanism may rock the harvesting device, so that the peduncles, side shoots and petioles become located in the valleys after all.

In a further embodiment, the guiding valleys are U-shaped or V-shaped, seen in the radial direction. Both the U-shape and the V-shape converge towards a central point at the bottom, so that, accordingly, the peduncles, side shoots and petioles are guided towards this central point during the upward movement of the harvesting device relative to the plant stem.

In an additional or alternative embodiment, the cutting member comprises a respective cutting device in each of the guiding valleys. In this way, the peduncles, side shoots and petioles automatically encounter a respective cutting device at the bottom of the valley, so that they are cut as soon as they reach the bottom of the valley.

In this embodiment, the cutting devices are only located at the bottoms of the valleys, which is only a fraction of the entire circumference of the plant passage, which enables that only certain parts of the circumference of the storage member receive harvested produce. In combination with a rotatable storage member, the harvested produce may be spread over the entire circumference of the storage member, thereby increasing its capacity. therefore

Each cutting device may be a cutting blade, for example comprising teeth that face upward along the longitudinal axis, so that the peduncles, side shoots and petioles are cut by means of the teeth.

In an embodiment of the harvesting device, e.g. according to the preamble of claim 1, the cutting member, e.g. the cutting devices, is an oscillatory cutting member, for example a sonic or ultrasonic cutting member. The cutting devices are thereby movable, for example configured to vibrate or oscillate inside the valleys. Such oscillations of the cutting device improve the cutting action and reduce the upward force that needs to act upon the plant stem by the harvesting device.

In an alternative embodiment of the harvesting device, e.g. according to the preamble of claim 1, the cutting member, e.g. the cutting devices, is a rotary cutting member, for example a rotary knife. Such a rotary cutting member may be embodied as a toothed rotary cutting member. The benefit of a rotary cutting member is that the reversals in movement direction occurring in oscillatory cutting members do not occurs, which further improves the cutting action by reducing the risk of jamming of the knife in case the harvesting is moved upward relative to the plant stem too fast.

Alternatively, the cutting devices may be stationary mounted to the guiding member, for example being mounted fixedly in each of the valleys.

In an embodiment, the harvesting device further comprises a sensor device, which is configured to detect the presence of horticultural produce adjacent the guiding passage and preferably to detect ripeness and/or weight of the produce.

The sensor device may be configured to transmit a sensor signal that is representative for the presence of products just prior to entering the plant passage upon movement of the harvesting device and, if products are detected, of the degree of ripeness, for example the colour if used for detecting tomatoes, and/or the size, for example the length of cucumbers.

In an embodiment, the harvesting device further comprises a release device, which is configured to allow for unloading, e.g. gravity-based unloading, of the storage member. The release device may for example comprise a movable ridge of the storage member, which is closed during cutting with the harvesting device, e.g. to prevent the produce from falling off, and which can be opened to allow the produce to slide off from the skirt surface in a controlled manner, to discharge the produce for packaging and/or further processing.

In an embodiment, the harvesting device further comprises a nozzle, attachable to a source of compressed air and configured to deliver bursts of compressed air at the storage member to remove leaves from the storage member. The nozzle may for example be spread across the storage member, e.g. spread over the skirt surface, so that any leaves or side shoots that remain on the storage member can be removed therefrom.

By means of the bursts of compressed air, the leaves and side shoots can be blown upwards, so that they are lifted from the storage member and fall off. Any produce on the storage member will not be affected by the bursts of air, because they have a weight that is significantly larger, so that they will not be lifted.

According to a second aspect, the present invention provides a harvesting apparatus, comprising a base, the harvesting device as described herein and an actuator device, configured to move the harvesting device relative to the base to move the harvesting device relative to the plant stem along the longitudinal axis.

The harvesting apparatus may have similar characteristics and benefits as the harvesting device according to the first aspect of the invention as described herein.

The base of the harvesting apparatus may be configured to remain stationary during cutting with the harvesting device, but may be movable to move the harvesting device between plants, e.g. from a first plant stem to a second plant stem.

During cutting, the actuator device is configured to move the harvesting with respect to the base, preferably in a substantial upward vertical direction. This movement may affect the relative movement along the plant stem, which may be held stationary, to perform the cutting of the peduncles, side shoots and petioles with the harvesting device.

In an embodiment, the harvesting apparatus comprises a harvesting device that comprises a sensor device, wherein the harvesting apparatus further comprising a control unit, which is configured to control movement of the harvesting device by the actuator device on the basis of sensor signals from the sensor device.

The control unit is configured to process sensor signals from the sensor device, so that the control unit can detect the presence of produce in front of the harvesting device. The control unit may be configured to compare the measured sensor signals with reference sensor signals, so that the control unit can make, for example, a comparison between a photograph made of a vine of tomatoes in front of the harvesting device and a reference image showing ripe tomatoes, so that the control unit can control the actuator device to cut the vine of tomatoes if that is found to be ripe enough.

According to a further aspect, the present invention provides a method of harvesting horticultural produce, side shoots and leaves from plant stems in greenhouse cultivation, for example by means of a harvesting device and/or harvesting apparatus as described herein, comprising the steps of:

- surrounding the plant stem at least partially in a plant passage by a guiding member of a harvesting device,
- moving the harvesting device along the plant stem along a longitudinal axis,
- guiding peduncles of the produce, the side shoots and/or petioles of the leaves that are attached to the plant stem by the guiding member,
- cutting the peduncles, the side shoots and/or the leaves by means of a cutting member of the harvesting device, to separate them from the plant stem, and
- collecting the produce that is separated from the plant stems in a storage member of the harvesting device.

The harvesting method may have similar characteristics and benefits as the harvesting device according to the first aspect of the invention as described herein.

In an embodiment, the method further comprises the step of dropping off the side shoots and leaves with the harvesting device.

Brief description of drawings

Further characteristics of the invention will be explained below, with reference to embodiments, which are displayed in the appended drawings, in which:

Figures 1a – 1d schematically depict several different plants with produce,

Figure 2a depicts a perspective view on an embodiment of the harvesting device according to the present invention,

Figure 2b depicts a top view on the harvesting device of figure 2a,

Figure 2c depicts a side view on the harvesting device of figure 2a during use,

Figure 3 schematically depicts the use of the harvesting device,

Figure 4 schematically depicts several possibilities of receiving a plant stem in the harvesting device,

Figure 5 schematically depicts several different harvesting devices with different skirt angles, and

Figures 6a – 6b schematically depict optional design features of the harvesting device.

Throughout the figures, the same reference numerals are used to refer to corresponding components or to components that have a corresponding function.

Detailed description of embodiments

Figures 1a – 1d schematically depict various types of plants 100 that are grown in greenhouse cultivation, each comprising a plant stem 101, which carries horticultural produce 102, leaves 103 and side shoots. Figure 1a shows a tomato plant 100, carrying vines of tomatoes 102. Figure 1b shows a cucumber plant 100', carrying cucumbers 102' and figure 1c shows an eggplant 100''. Figure 1d is a magnification of the encircled area in figure 1c, which shows that the leaves 103'' are attached to the plant stem 101'' by means of petioles 104'' and that the produce, e.g. the eggplants 102'', is attached to the plant stem 101'' by means of peduncles 105''.

Figures 2a, 2b and 2c show an embodiment of the harvesting device according to the present invention, to which is referred with reference numeral 1. The harvesting device 1 comprises a crown-shaped guiding member 10, which defines a through plant passage 11. The harvesting device 1 is configured to receive the plant stem 101 inside the plant passage 11 of the guiding member 10. The passage 11 extends along the longitudinal axis L-L, so that the plant stem 101 extends along the longitudinal axis L-L as well. The longitudinal axis L-L is, in the present embodiment, aligned substantially vertically and upward.

The harvesting device 1 is configured to be guided with respect to the plant stem 101 as a result of the plant stem 101 being received in, in particular being partly surrounded by the through plant passage 11 in the guiding member 10. According to the present embodiment, the harvesting device 1 is moved with respect to its surroundings and the plant stem 101 follows the movement of the guiding member 10.

The guiding member 10 comprises four tips 12, which are aligned upwardly and substantially parallel to the longitudinal axis L-L and which are spaced around the circumference of the plant passage 11. The guiding member 10 further comprises three tapered guiding valleys 13 in between the tips 12.

The crown-shape is configured to effect sideways guiding of the peduncles 105, side shoots and petioles 104 as a result of the tapered guiding valleys 13 in between each two

adjacent tips 12. With the crown-shape, the peduncles 105, side shoots and petioles 104 are guided to certain discrete locations in the valleys 13, where a cutting member 20 is provided, as is shown schematically in figure 6a. As a result, the cutting member 20 not needs to be arranged around the entire circumference of the plant passage 11, but instead only at the location to which the peduncles 105, side shoots and petioles 104. In figures 2a – 2c, the valleys 13 are shown to be U-shaped.

Alternatively, the valleys may be V-shaped, as is shown schematically in figure 6a. It is shown in figure 6b that the harvesting device may comprise a rocking mechanism, which is configured to tilt the harvesting device 1, shown by means of the waved line, with respect to a horizontal tilting axis. The tilting may contribute in the guiding of the peduncles 105, side shoots and petioles 104 of the plant 100 into the valleys and towards the cutting member.

The harvesting device 1 further comprises a cutting member 20, which is attached to the guiding member 10 and which is configured to cut the peduncles 104, the side shoots and the petioles 104 that pass the guiding member 10 during movement of the harvesting device 1 along the plant stem 101. The cutting member 20 is configured to be moved relative to the plant stem 101 in conjunction with the guiding member 10 and partly surrounds the through plant passage 11 in a way similar to the surrounding by the guiding member 10.

Upon relative movement between the plant stem 101 and the harvesting device 1 along the plant stem 101, the harvesting device 1 encounters the produce 102, the side shoots and leaves 103. The cutting member 20 is configured to cut-off all of these when they come to face the cutting member 20 when the harvesting device 1 is moved with respect to the plant stem 101, e.g. to perform a so-called stripping action onto the plant stem 101.

In the embodiment of figures 2a – 2c, the cutting member 20 comprises a respective cutting device 21 in each of the guiding valleys 13. In this way, the peduncles 105, side shoots and petioles 104 automatically encounter a respective cutting device 21 at the bottom of the valley 13, so that they are cut as soon as they reach the bottom of the valley 13. Each cutting device is embodied as a cutting blade 21, comprising teeth that face upward along the longitudinal axis L-L, so that the peduncles 105, side shoots and petioles 104 are cut by means of the teeth.

In the embodiment in figures 2a – 2c, the cutting member 20 is an oscillatory cutting member, comprising a plurality of oscillatory actuators 22, positioned below the guiding member 10, each being connected to its own respective cutting blade 21 to oscillate the cutting blade 21 within the respective valley 13. Alternatively, the cutting member may be provided as a rotary cutting member.

The harvesting device 1 further comprises a storage member 30, which is configured to collect the produce 102 that is separated from the plant stems 101 and configured to drop off the side shoots and leaves 103. The storage member 30 surrounds the guiding member 10 in a way similar the guiding member 10 surrounds the through plant passage 11.

The storage member 30 projects away from the guiding member 10 and the cutting member 20 in directions radial R to the longitudinal axis L-L, as is best shown in figure 2b. The storage member 30 thus has a larger footprint than the guiding member 10 and the cutting member 20. This larger contour ensures that the storage member 10 project underneath the horticultural produce 102, which produce 102 is located radially outside the cutting member 20, as is shown in figure 2c.

After cutting, the horticultural produce 105 is caught on the storage member 30. The storage member 30 is configured to autonomously collect the horticultural produce 102 that has been cut off from the plant stem by the cutting member 20, e.g. without requiring active steps in terms of movement of the storage member 30 towards the produce 102. The produce 102 in particular drops onto the storage member 30 after cutting under the influence of gravitational forces acting onto the produce 102. The storage member 30 is configured to drop off the side shoots and leaves 104, since these are not desired to be stored.

The storage member 30 comprising an at least partially cone-shaped skirt surface 31, which tapers outwardly in the radial direction R upon increasing distance from the cutting member 20 in the downward vertical direction. The skirt surface 31 surrounds the guiding member 10 and the cutting member 20 and forms a support surface for the produce 102 to land on after cutting and to be collected for further handling.

The storage member 30 further comprises a circumferential ridge 32 at the bottom edge of the skirt surface 30, which is configured to prevent the produce 102 from falling off the skirt surface 31 at the bottom.

The harvesting device 1 shown in figures 2a – 2c comprises a side aperture 2, which provides access to the plant passage 11 in an access direction A substantially perpendicular to the longitudinal axis L-L to allow entry in and exit from the plant stem 101 in the plant passage 11 in the access direction A. The guiding member 10, the cutting member 20 and the storage member 30 thereby form a unitary harvesting device 1.

It is shown schematically in figure 5 that the skirt surface 31 is set at a skirt angle ($\alpha_{skirt,\ slope}$) with respect to the longitudinal axis L-L, which skirt angle ($\alpha_{skirt,\ slope}$) is selected in the range between 30° and 60°. The skirt angle ($\alpha_{skirt,\ slope}$) can be varied to alter the steepness of the skirt surface 31 and therefor changes the properties of the storage member 30.

The skirt angle ($\alpha_{skirt,\ slope}$) is selected to optimally support the produce 102 after cutting and to avoid the produce 102 from falling onto the skirt surface 31. The skirt angle ($\alpha_{skirt,\ slope}$)

can be selected in dependence of the type of produce 102 that is to be harvested, so that the skirt surface 31 may be aligned substantially parallel to an elongate direction in which the produce 102 substantially extends.

For example, cucumbers, as shown in no. [2] in figure 5, hang almost vertically from the plant stem, which implies that the skirt angle ($\alpha_{skirt,\ slope}$) is then selected relatively small. However, vine tomatoes, in no. [01], grow at an angle (α_{fruit}) more horizontally than cucumbers, which implies that the skirt angle ($\alpha_{skirt,\ slope}$) can be selected larger in case the harvesting device 1 is used for harvesting tomatoes.

In a way similar to the selection of the skirt angle ($\alpha_{skirt,\ slope}$), may the height L of the skirt surface 31 be selected on the basis of the length of the produce that is to be harvested. For tomatoes, as shown in no. [1] in figure 5, the height L may be selected average. If the harvesting device 1 is used for harvesting cucumbers, as shown in no. [2], the height L+ can be selected larger than the height L- of a harvesting device that is used to harvest bell peppers, as shown in no. [3], which are shorter than cucumbers.

It is shown schematically in no. [4] of figure 5 that the skirt surface 31 may comprise a first skirt section 31, which is located directly below the guiding member and forms an initial support for the produce 102, prior to being cut by the cutting device. The skirt surface 31 may further comprise a second skirt section 31'' that is aligned more horizontally than the first skirt section 31', e.g. having a large skirt angle than the first skirt section 31', to that the cut produce 31 will slow down after sliding from the first skirt section 31' and that the produce is collected on the second skirt section 31''.

Figure 3 schematically shows operation of the harvesting device, used for harvesting vine tomatoes and for cutting leaves from the tomato plant stem. At step [1], the harvesting device is arranged in place around the plant stem and at step [2], first and second harvesting device parts are brought towards each other to enclose the plant stem.

At step [3], the harvesting devices is moved upward along the plant stem. The cutting member of the harvesting device is represented by means of the dashed line, which cutting member has encountered a vine of tomatoes at step [4]. The cutting member has cut the peduncle to effect that the vine of tomatoes become arranged on the storage member.

At step [5], the cutting member encounters a leaf of the tomato plant, which is also cut by the cutting member, but which does not drop on the storage member, but instead tilts over the outer edge of the storage member. Hence, tomato leaves have a somewhat triangular shape with a size of approximately 50 centimetres, whereas a vine of tomatoes is approximately elongate with a length of only 20 centimetres and a weight that is approximately 10 times higher than that of the leave. The storage member has a width that is

such that the centre of gravity of the vine of tomatoes falls within the contour of the storage member, whereas the centre of gravity of the leave falls outside the contour of the storage member, so that the leave will tilt over the outer edge of the storage member after having dropped thereon and that the leaves will fall from the storage member accordingly.

At step [6], finally, the harvesting device detects with a sensor device that the next vine of tomatoes is not yet ripe, e.g. having a green instead of red colour. Accordingly, the harvesting device is not moved upward along the plant stem any further, because this unripe vine may not yet be harvested.

Step [A] in figure 5 shows the harvesting device with the vine of tomatoes on the storage member. The harvesting device may comprise a release device, which is configured to allow for gravity-based unloading, of the storage member. The release device is embodied as a movable ridge of the storage member, which is closed during cutting with the harvesting device, e.g. to prevent the produce from falling off, as is shown in step [A]. The movable ridge can be opened, as shown in step [B], and the produce is allowed to slide off from the skirt surface in a controlled manner, as shown in step [C], to discharge the produce for packaging and/or further processing. At step [C] in figure 5, it is shown that the produce may for example be discharge in a packaging, e.g. as shown on the left, or on a conveyor belt, as shown on the right.

Figures 4a – 4c show alternative embodiments of the harvesting device, which fully enclose the plant stem during use for harvesting produce. In these harvesting devices, the guiding member, the cutting member and the storage member are together subdivided in a first device part 3 and in a second device part 4.

The separation of the harvesting device in the first device part 3 and the second device 4 part is done in a plane parallel to the longitudinal axis, so that the separation between the parts is visible in the plane perpendicular to the longitudinal axis, for example when looking downward onto the harvesting device as in figures 4a – 4c.

In figures 4a – 4c, a relative displacement between the plant stem and the harvesting device is shown. This may imply that the plant stem is stationary and that the harvesting device is moved towards the plant stem. Alternatively, it may imply that the harvesting device is stationary and that the plant stem is moved towards the harvesting device. As a further alternative, both the plant stem and the harvesting device may be movable.

The first device part 3 is an integral part of a first guiding member part, a first cutting member part and a first storage member part. The second device part 4 is an integral part of a second guiding member part, a second cutting member part and a second storage member

part. The integral first device part 3 is entirely separable from and movable relative to the integral second device part 4.

The first device part 3 and the second device 4 can be moved away from each other in an opened configuration to allow entry in and exit from the plant stem 101 in the plant passage 11 in a radial direction perpendicular to the longitudinal axis. In figures 4a – 4c, the left image shows the device parts 3, 4 in the opened configuration, displaying entry of the plant stem 101.

The first device part 3 and the second device 4 can be moved towards each other in a closed configuration, in which the first device part 3 and the second device part 4 are arranged against each other, to fully enclose the plant passage 11, i.e. to fully surround the plant stem 101. On the right, in figures 4a – 4c, the first device part 3 and the second device 4 are shown in the closed configuration.

Figure 4a shows a first option for how the harvesting device can be subdivided in a first device part 3 and a second device part 4. In this embodiment, the first device part 3 and the second device part 4 are, upon movement between the opened configuration and the closed configuration rotatable relative to each other about an axis of rotation parallel to the longitudinal axis. The device parts 3, 4 are thereby attached to each other by means of a hinge 5 to allow the relative rotation between them. The hinge 5 is the sole connection between the device parts 3, 4in the opened configuration, e.g. on the left in figure 4a, in which the device parts 3, 4 have rotated away from each other about the axis of rotation. When the device parts 3, 4 are moved into the closed configuration, the device parts 3,4 are rotated towards each other, so that they also come to abut each other opposite to the hinge 5.

Figure 4b shows an alternative embodiment, in which the first device part 3' and the second device part 4' are, upon movement between the opened configuration and the closed configuration displaceable relative to each other in a displacement direction D perpendicular to the longitudinal axis. According to this embodiment, the device parts 3', 4' are displaced with respect to each other by means of a linear actuator 6. As such, the device parts 3' ,4' are set at a distance from each other in the opened configuration, e.g. on the left in figure 4b, and abut each other in the closed configuration, e.g. on the right in figure 4b.

Figure 4c shows a further alternative embodiment, comprising a first device part 3'' that almost completely surrounds the plant passage, but which further comprises a second device part 4'', which is completely removable from and connectable to the first device part 3'', respectively, upon moving towards the opened configuration, e.g. on the left in figure 4c, and towards the closed configuration, e.g. on the right in figure 4c.

C O N C L U S I E S

1. Oogstinrichting voor het oogsten van tuinbouwproducten, zijscheuten en/of bladeren van plantstengels in de glastuinbouw, de inrichting omvattende:

- een geleidingsorgaan, dat een doorlopende plantdoorgang definieert en dat is ingericht om de plantstengel tijdens gebruik ten minste gedeeltelijk in de plantdoorgang te omringen, en
- een snijorgaan, dat is bevestigd aan het geleidingsorgaan en dat is ingericht om stelen van de producten, de zijscheuten en/of bladstelen van de bladeren die aan de plantstengels zijn bevestigd af te snijden om ze van de plantstengels te scheiden, waarbij de plantstengels zijn ingericht om binnen het geleidingsorgaan te worden geleid bij relatieve bewegingen van de oogstinrichting langs de plantstengel langs een lengteas, d.w.z. in een opwaartse verticale richting, en

waarbij het snijorgaan is ingericht voor het afsnijden van de stelen, de zijscheuten en/of de bladstelen die door het geleidingsorgaan lopen tijdens beweging van de oogstinrichting,

met het kenmerk dat,

de oogstinrichting verder omvat:

- een opslagorgaan dat het geleidingsorgaan ten minste gedeeltelijk omringt en dat is ingericht om de producten te verzamelen die zijn gescheiden van de plantstengels en bij voorkeur zijn ingericht om de zijscheuten en bladeren te laten vallen.

2. Oogstinrichting volgens conclusie 1, waarbij het opslagorgaan roteerbaar is ten opzichte van het geleidingsorgaan en/of het snijorgaan om de lengteas.

3. Oogstinrichting volgens conclusie 1 of 2, verder omvattende een schommelmechanisme, dat is ingericht om de oogstinrichting te kantelen ten opzichte van een horizontale kantelas.

4. Oogstinrichting volgens een van de voorgaande conclusies, waarbij het geleidingsorgaan, het snijorgaan en het opslagorgaan tezamen, gezien in een vlak loodrecht op de lengteas, zijn onderverdeeld in:

- een eerste inrichtingsdeel, omvattende een eerste geleidingsorgaandeel, een eerste snijorgaandeel en een eerste opslagorgaandeel, en in
- een tweede inrichtingsdeel, omvattende een tweede geleidingsorgaandeel, een tweede snijorgaandeel en een tweede opslagorgaandeel,

waarbij het eerste inrichtingsdeel en de tweede inrichting van elkaar weg kunnen worden bewogen in een geopende configuratie om in- en uittreden van de plantstengel

in de plantdoorgang mogelijk te maken in een radiale richting loodrecht op de lengteas, en
waarbij het eerste inrichtingsdeel en de tweede inrichting naar elkaar toe kunnen worden bewogen in een gesloten configuratie om de plantdoorgang te omsluiten, d.w.z. om de plantstengel volledig te omringen.

5. Oogstinrichting volgens conclusie 4, waarbij het eerste inrichtingsdeel en het tweede inrichtingsdeel, bij beweging tussen de geopende configuratie en de gesloten configuratie:
- roteerbaar zijn ten opzichte van elkaar om een rotatie-as evenwijdig aan de lengteas, en/of
- verplaatsbaar zijn ten opzichte van elkaar in een verplaatsingsrichting loodrecht op de lengteas.

6. Oogstinrichting volgens een van de conclusies 1 – 3, verder omvattende een zijopening, die toegang verschaft tot de plantdoorgang in een toegangsrichting in hoofdzaak loodrecht op de lengteas om in- en uittreden van de plantstengel in de plantdoorgang mogelijk te maken in de toegangsrichting.

7. Oogstinrichting volgens een van de voorgaande conclusies, waarbij het opslagorgaan een rokvlak omvat, bijvoorbeeld een ten minste gedeeltelijk kegelvormig rokvlak, dat naar buiten taps toeloopt in de radiale richting bij toenemende afstand van het snijorgaan, d.w.z. in neerwaartse verticale richting.

8. Oogstinrichting volgens conclusie 7, waarbij het rokvlak onder een rokhoek is geplaatst ten opzichte van de lengteas, en
waarbij de rokhoek bij voorkeur is gekozen in het bereik tussen 30° en 60°.

9. Oogstinrichting volgens conclusie 8, waarbij het rokoppervlak omvat:
- een eerste rokgedeelte, dat is bevestigd aan het geleidingsorgaan, bijvoorbeeld zich onder het geleidingsorgaan bevindt, en
- een tweede rokgedeelte, dat aan een zijde tegenover het geleidingsorgaan is bevestigd aan het eerste rokgedeelte, bijvoorbeeld zich onder het eerste rokgedeelte bevindt,

waarbij het eerste rokgedeelte onder een eerste rokhoek is geplaatst en waarbij het tweede rokgedeelte onder een tweede rokhoek is geplaatst, en
waarbij de tweede rokhoek groter is dan de eerste rokhoek.

10. Oogstinrichting volgens een van de voorgaande conclusies, waarbij het snijorgaan, gezien in de radiale richting, op afstand is geplaatst van de plantdoorgang, en waarbij de afstand bij voorkeur is geselecteerd in het bereik tussen 5 mm en 15 mm.

11. Oogstinrichting volgens een van de voorgaande conclusies, waarbij het geleidingsorgaan kroonvormig is, omvattend:
- meerdere punten, die naar boven en in hoofdzaak parallel aan de lengteas zijn uitgelijnd en die zijn verspreid rond de omtrek van de plantdoorgang, en
- een respectief taps toelopend geleidingsdal tussen elke twee aangrenzende punten.

12. Oogstinrichting volgens conclusie 11, waarbij de geleidingsdalen U-vormig of V-vormig zijn, gezien in de radiale richting.

13. Oogstinrichting volgens conclusie 11 of 12, waarbij het snijorgaan een respectievelijke snijinrichting in elk van de geleidingsdalen omvat.

14. Oogstinrichting volgens de aanhef van conclusie 1, waarbij het snijorgaan, bijvoorbeeld de snijinrichtingen, een oscillerend snijorgaan is, bijvoorbeeld een sonisch of ultrasoon snijorgaan.

15. Oogstinrichting volgens de aanhef van conclusie 1, waarbij het snijorgaan, bijvoorbeeld de snijinrichtingen, een roterend snijorgaan is, bijvoorbeeld een roterend mes.

16. Oogstinrichting volgens een van de voorgaande conclusies, verder omvattende een sensorinrichting, die is ingericht om de aanwezigheid van tuinbouwproducten nabij de geleidingsdoorgang te detecteren en bij voorkeur om rijpheid en/of gewicht van de producten te detecteren.

17. Oogstinrichting volgens een van de voorgaande conclusies, verder omvattende een losinrichting, die is ingericht om lossen van het opslagorgaan, bijvoorbeeld op zwaartekracht gebaseerd lossen, mogelijk te maken.

18. Oogstinrichting volgens een van de voorgaande, verder omvattende een uitstroomopening, bevestigbaar aan een persluchtbron en ingericht om stoten perslucht af te geven naar het opslagorgaan om bladeren van het opslagorgaan te verwijderen.

19. Oogstinrichting, omvattende een basis, de oogstinrichting volgens een van de voorgaande conclusies en een actuatorinrichting, ingericht om de oogstinrichting te verplaatsen ten opzichte van de basis om de oogstinrichting ten opzichte van de plantstengel langs de lengteas te verplaatsen.

20. Oogstinrichting volgens conclusie 19, omvattende de oogstinrichting volgens conclusie 16, waarbij de oogstinrichting verder een regelinrichting omvat, die is ingericht om beweging van de oogstinrichting door de actuatorinrichting aan te sturen op basis van sensorsignalen van de sensorinrichting.

21. Werkwijze voor het oogsten van tuinbouwproducten, zijscheuten en bladeren van plantstengels in de glastuinbouw, omvattende de stappen van:
- het ten minste gedeeltelijk omringen van de plantstengel in een plantdoorgang door een geleidingsorgaan van een oogstinrichting,
- het langs een lengteas langs de plantstengel verplaatsen van de oogstinrichting,
- het door het geleidingsorgaan geleiden van stelen van de producten, de zijscheuten en/of bladstelen van de bladeren die zijn bevestigd aan de plantstengel,
- het afsnijden van de stelen, de zijscheuten en/of de bladeren door middel van een snijorgaan van de oogstinrichting, om deze van de plantstengel te scheiden, en
- het verzamelen van de producten die gescheiden zijn van de planstengels in een opslagorgaan van de oogstinrichting.

22. Werkwijze volgens conclusie 21, verder omvattende de stap van het met de oogstinrichting laten vallen van de zijscheuten en bladeren.

Fig. 1A

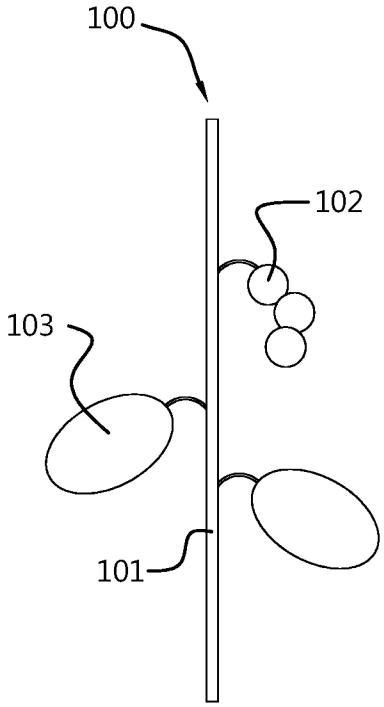


Fig. 1B

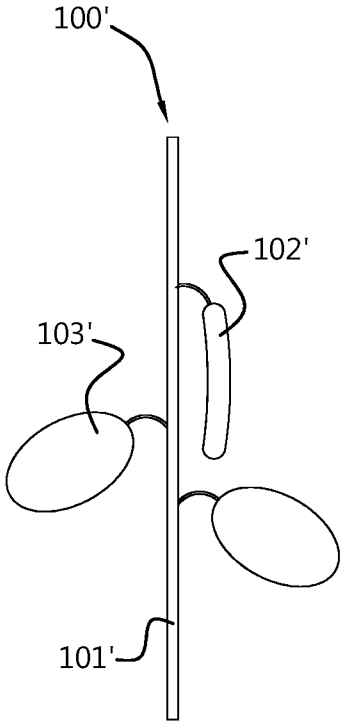


Fig. 1C

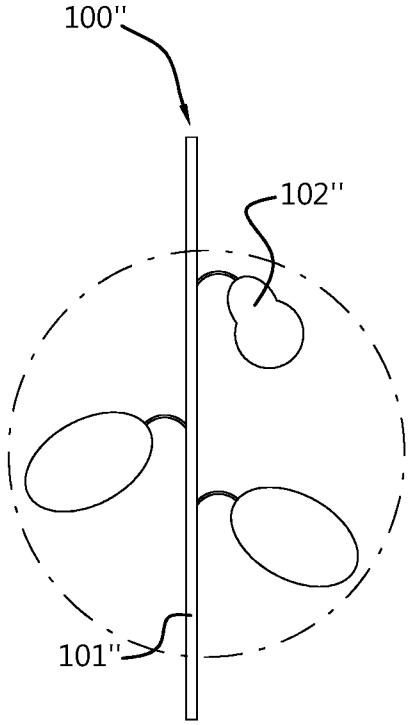


Fig. 1D

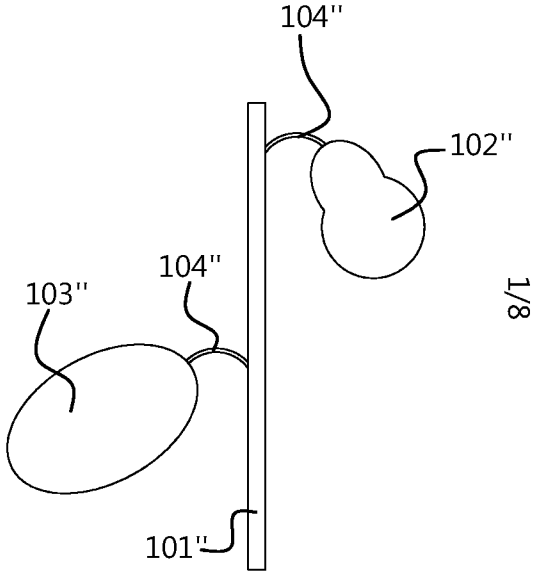


Fig. 2A

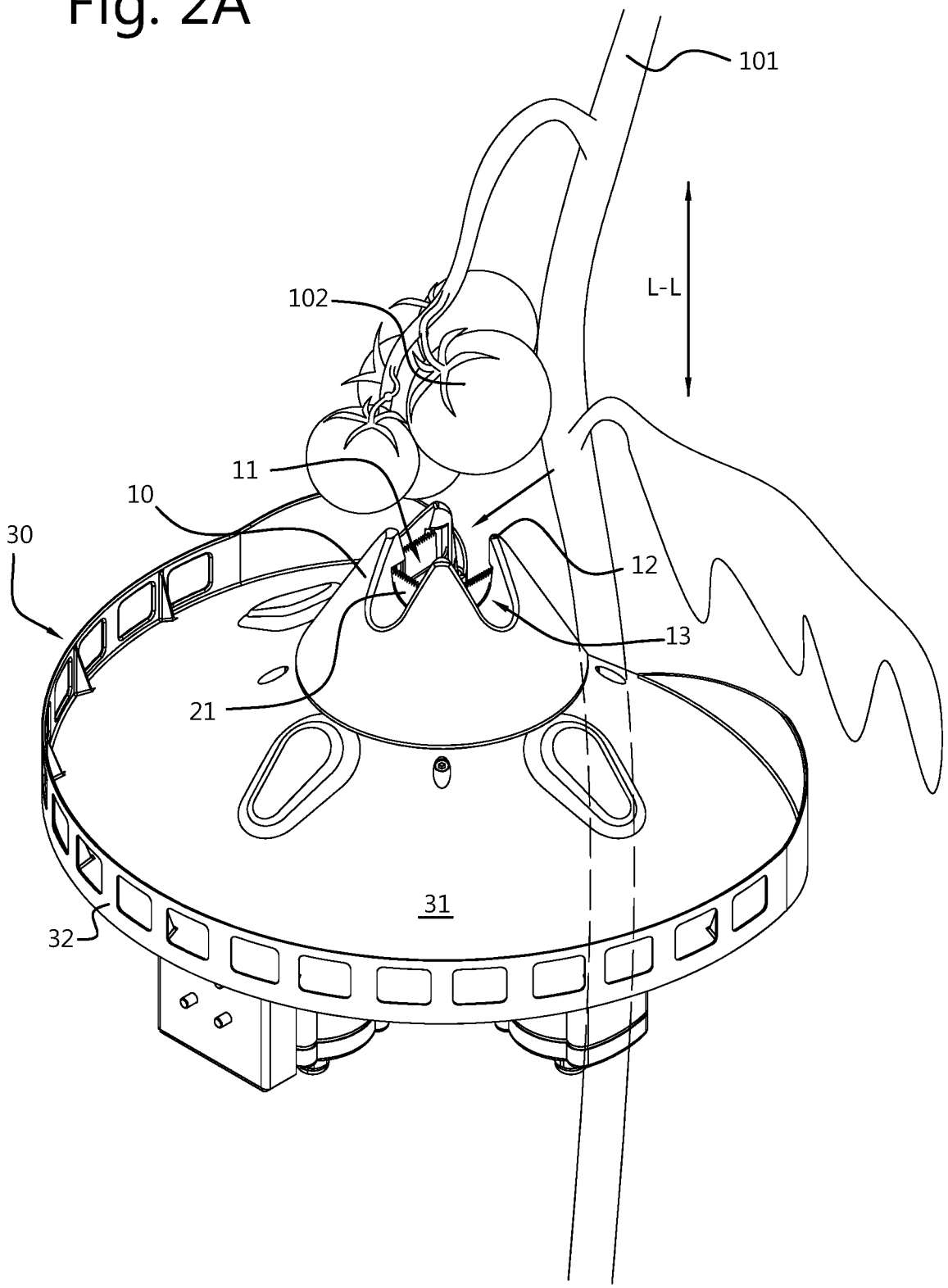


Fig. 2B

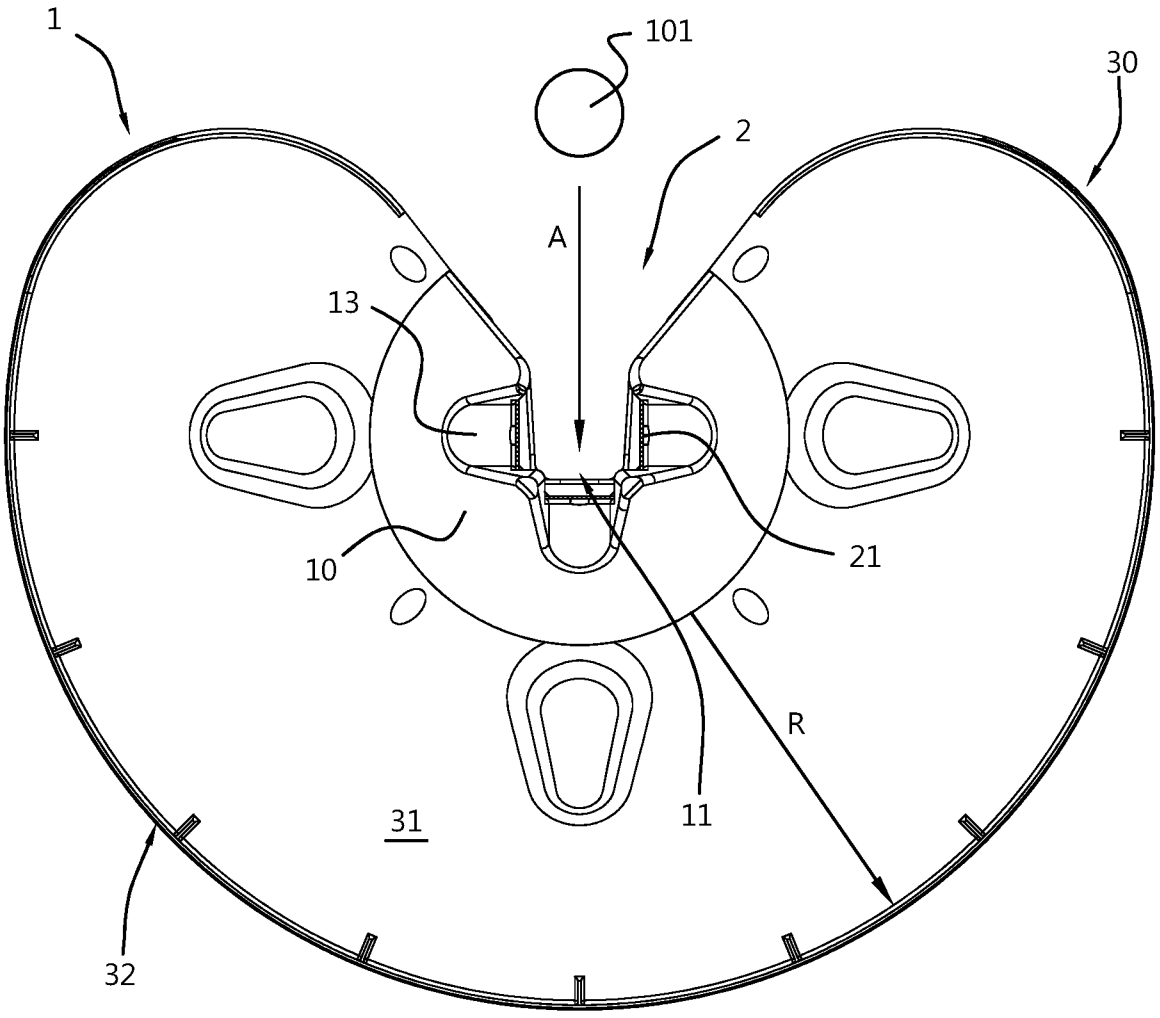


Fig. 2C

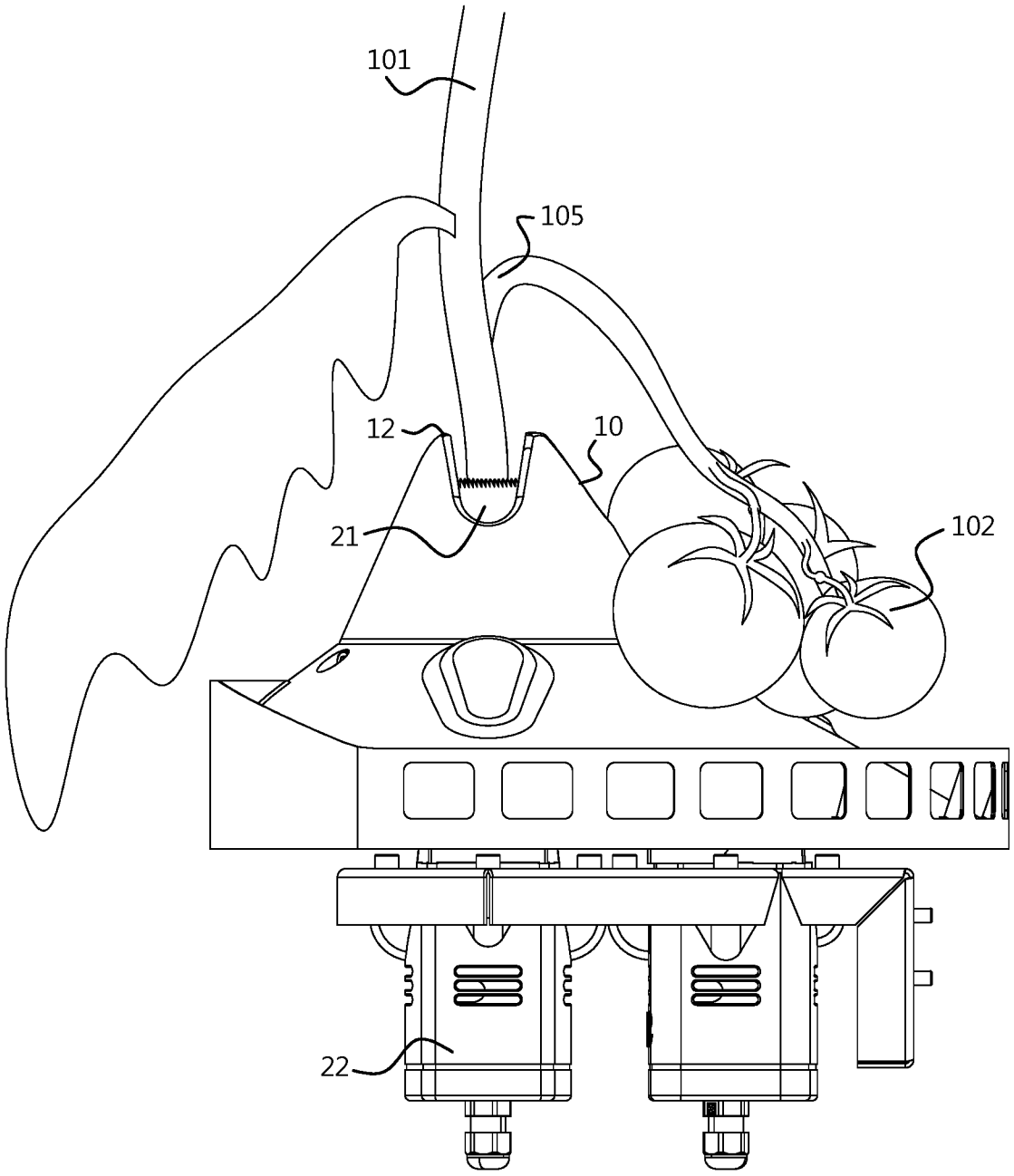


Fig. 3.1

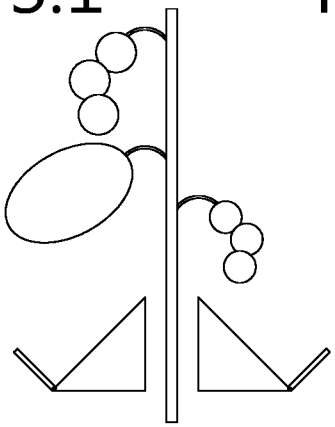


Fig. 3.2

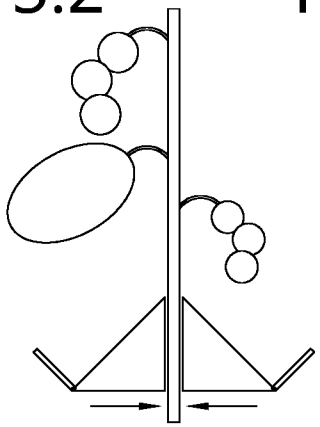


Fig. 3.3

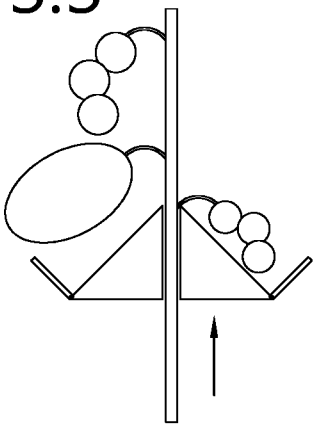


Fig. 3.4

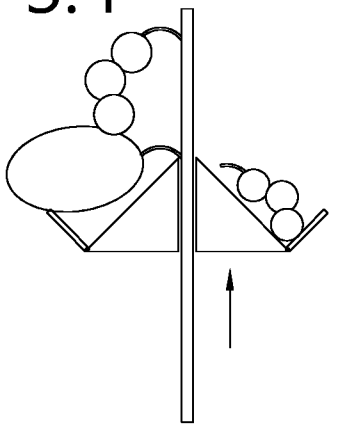


Fig. 3.5

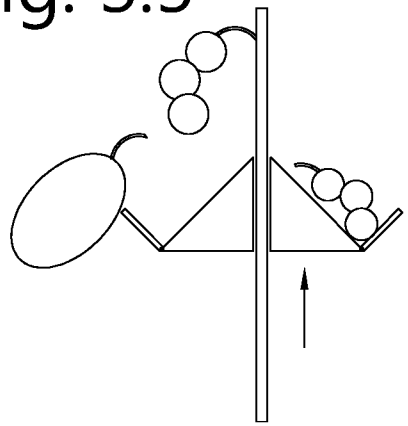


Fig. 3.6

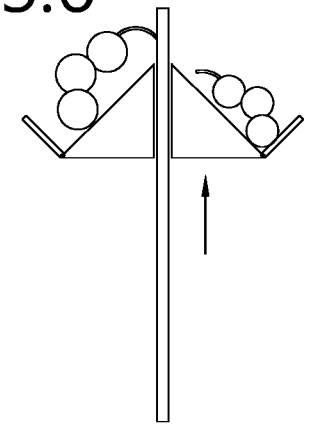


Fig. 3A

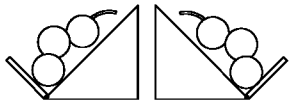


Fig. 3B

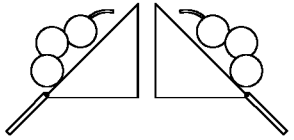
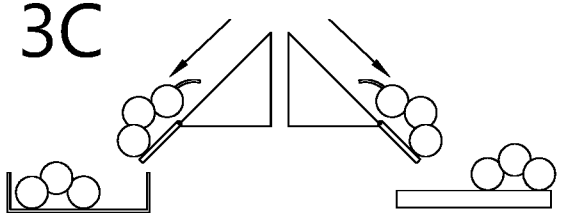


Fig. 3C



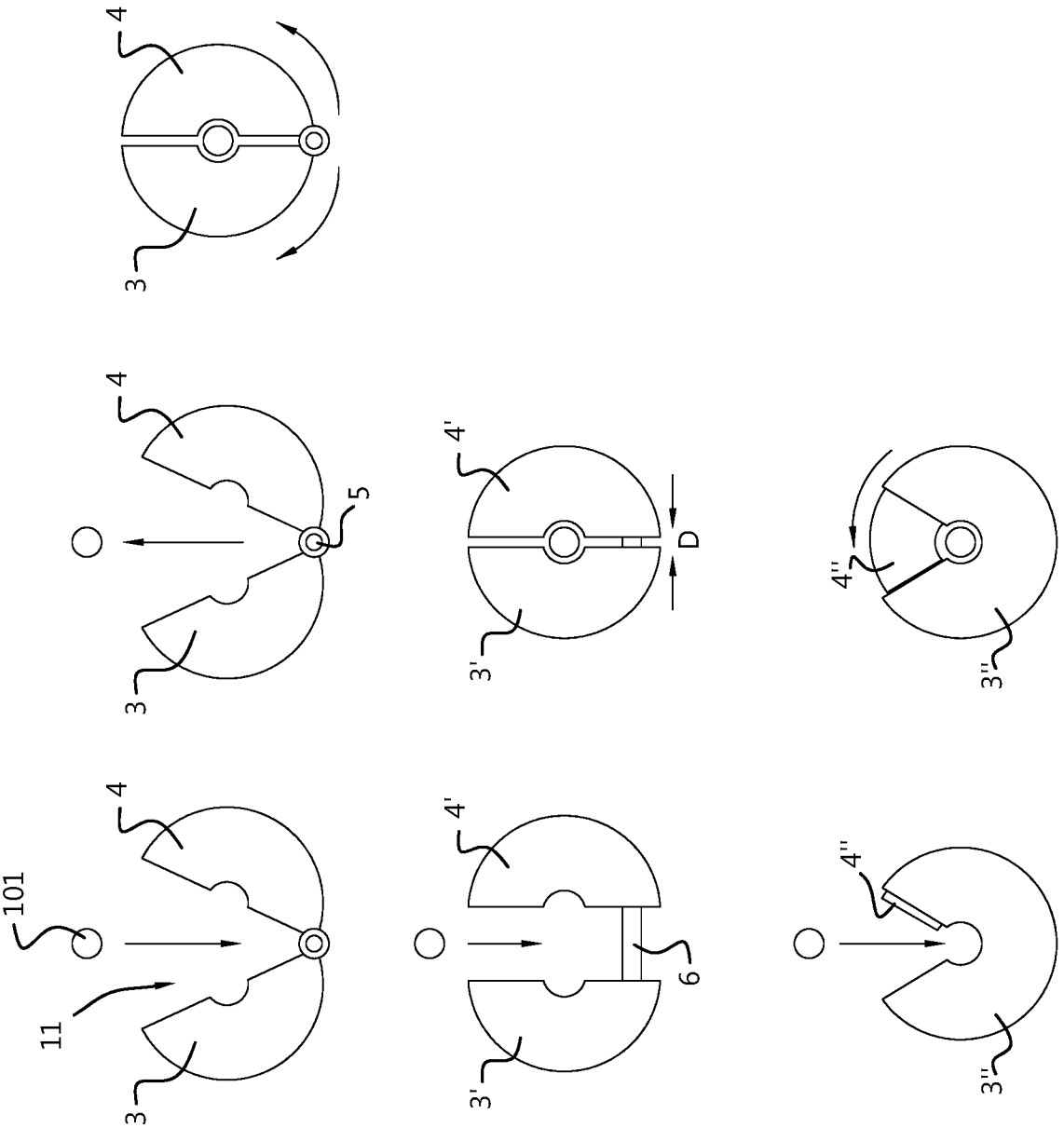


Fig. 4A

Fig. 4B

Fig. 4C

Fig. 5.1

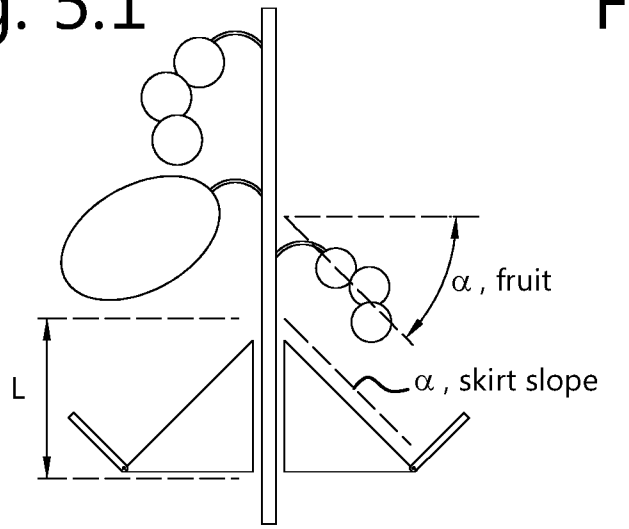


Fig. 5.2

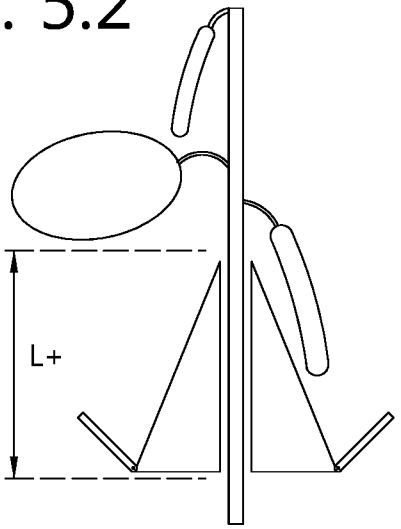


Fig. 5.3

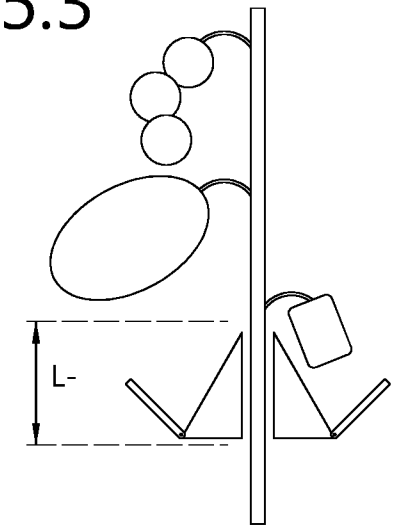


Fig. 5.4

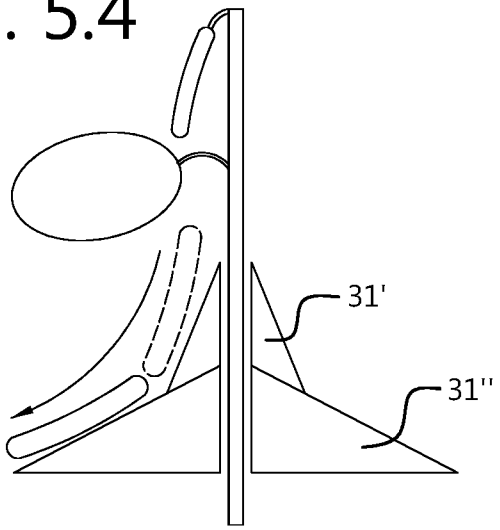


Fig. 6A

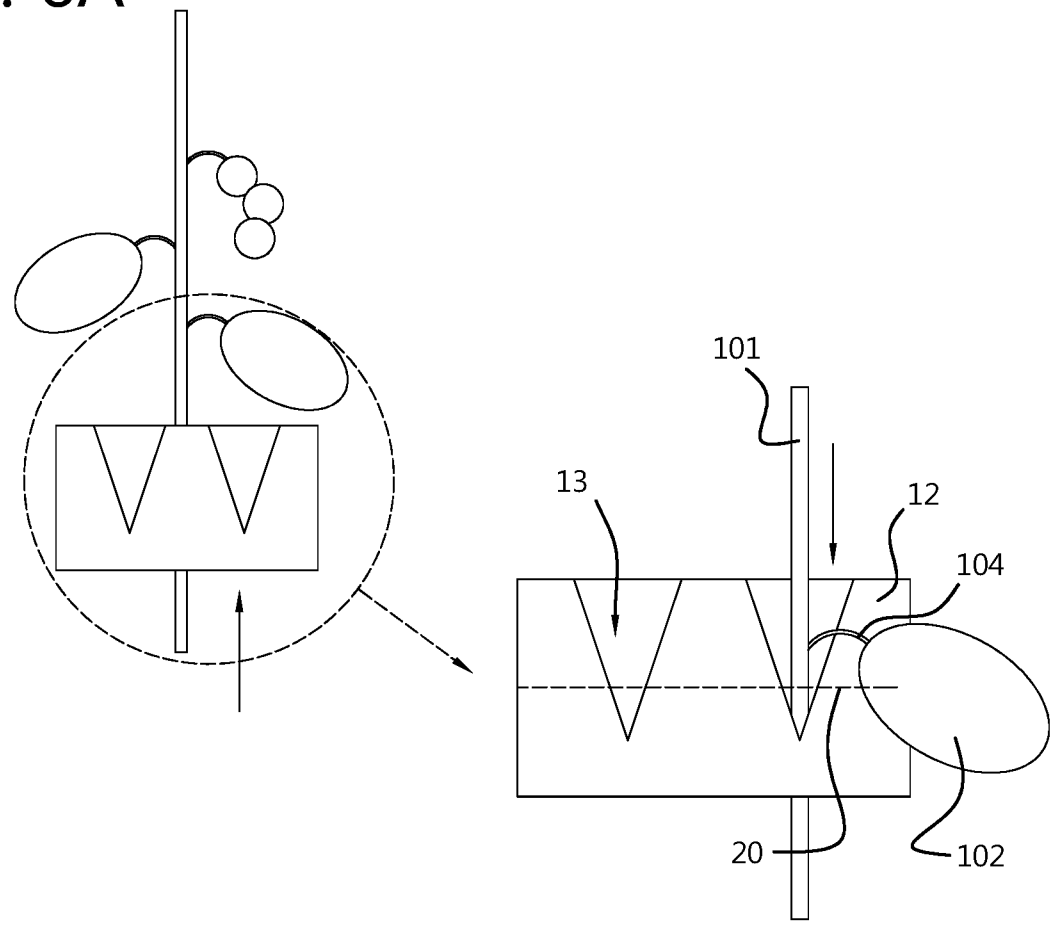
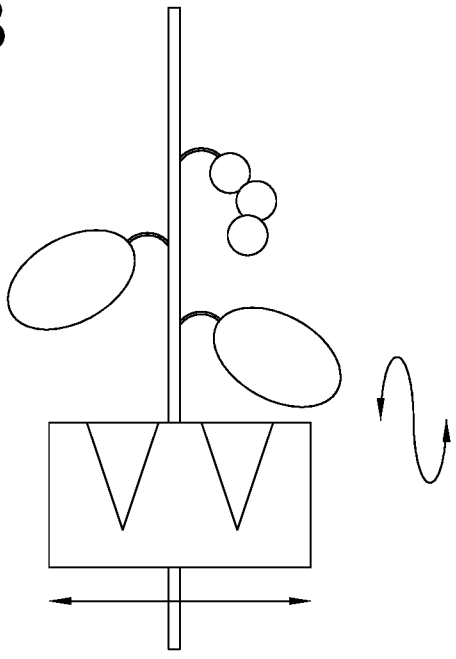


Fig. 6B



SAMENWERKINGSVERDRAG (PCT)

RAPPORT BETREFFENDE NIEUWHEIDSONDERZOEK VAN INTERNATIONAAL TYPE

IDENTIFICATIE VAN DE NATIONALE AANVRAGE	KENMERK VAN DE AANVRAGER OF VAN DE GEMACHTIGDE
Nederlands aanvraag nr. **2028660**	Indieningsdatum **08-07-2021**
	Ingeroepen voorrangsdatum
Aanvrager (Naam) **Saia Holding B.V.**	
Datum van het verzoek voor een onderzoek van internationaal type **02-10-2021**	Door de Instantie voor Internationaal Onderzoek aan het verzoek voor een onderzoek van internationaal type toegekend nr. **SN79692**

I. CLASSIFICATIE VAN HET ONDERWERP (bij toepassing van verschillende classificaties, alle classificatiesymbolen opgeven)

Volgens de internationale classificatie (IPC)

Zie onderzoeksrapport

II. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte minimumdocumentatie

Classificatiesysteem	Classificatiesymbolen
IPC	**Zie onderzoeksrapport**

Onderzochte andere documentatie dan de minimum documentatie, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

III.	☐	**GEEN ONDERZOEK MOGELIJK VOOR BEPAALDE CONCLUSIES**	(opmerkingen op aanvullingsblad)
IV.	☐	**GEBREK AAN EENHEID VAN UITVINDING**	(opmerkingen op aanvullingsblad)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2028660

A. CLASSIFICATIE VAN HET ONDERWERP

INV. A01D46/24 A01G3/00 A01G3/08
ADD. A01D45/00

Volgens de Internationale Classificatie van octrooien (IPC) of zowel volgens de nationale classificatie als volgens de IPC.

B. ONDERZOCHTE GEBIEDEN VAN DE TECHNIEK

Onderzochte miminum documentatie (classificatie gevolgd door classificatiesymbolen)
A01D A01G

Onderzochte andere documentatie dan de mimimum documentatie, voor dergelijke documenten, voor zover dergelijke documenten in de onderzochte gebieden zijn opgenomen

Tijdens het onderzoek geraadpleegde elektronische gegevensbestanden (naam van de gegevensbestanden en, waar uitvoerbaar, gebruikte trefwoorden)
EPO-Internal, WPI Data

C. VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
X	WO 2005/058013 A1 (AGRARISCH LOONBEDRIJF C PELLIK [NL]; PELLIKAAN CORNELIS [NL]) 30 juni 2005 (2005-06-30)	1-6,10, 14-22
A	* bladzijde 1, regel 5 - regel 10 * * bladzijde 5, regel 27 - bladzijde 6, regel 10 * * bladzijde 9, regel 1 - regel 22 * * bladzijde 10, regel 38 - bladzijde 12, regel 19 * * figuren 2a, 2b, 3, 10 *	7-9, 11-13

X	US 3 353 575 A (LARSON ROBERT W ET AL) 21 november 1967 (1967-11-21) * samenvatting * * figuren 3, 6, 7 *	14,15

	-/--	

[X] Verdere documenten worden vermeld in het vervolg van vak C.

[X] Leden van dezelfde octrooifamilie zijn vermeld in een bijlage

° Speciale categorieën van aangehaalde documenten

"A" niet tot de categorie X of Y behorende literatuur die de stand van de techniek beschrijft

"D" in de octrooiaanvrage vermeld

"E" eerdere octrooi(aanvrage), gepubliceerd op of na de indieningsdatum, waarin dezelfde uitvinding wordt beschreven

"L" om andere redenen vermelde literatuur

"O" niet-schriftelijke stand van de techniek

"P" tussen de voorrangsdatum en de indieningsdatum gepubliceerde literatuur

"T" na de indieningsdatum of de voorrangsdatum gepubliceerde literatuur die niet bezwarend is voor de octrooiaanvrage, maar wordt vermeld ter verheldering van de theorie of het principe dat ten grondslag ligt aan de uitvinding

"X" de conclusie wordt als niet nieuw of niet inventief beschouwd ten opzichte van deze literatuur

"Y" de conclusie wordt als niet inventief beschouwd ten opzichte van de combinatie van deze literatuur met andere geciteerde literatuur van dezelfde categorie, waarbij de combinatie voor de vakman voor de hand liggend wordt geacht

"&" lid van dezelfde octrooifamilie of overeenkomstige octrooipublicatie

Datum waarop het onderzoek naar de stand van de techniek van internationaal type werd voltooid	Verzenddatum van het rapport van het onderzoek naar de stand van de techniek van internationaal type
22 februari 2022	

Naam en adres van de instantie	De bevoegde ambtenaar
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	**Nicolai, Sébastien**

1

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Nummer van het verzoek om een onderzoek naar de stand van de techniek
NL 2028660

C.(Vervolg). VAN BELANG GEACHTE DOCUMENTEN

Categorie °	Geciteerde documenten, eventueel met aanduiding van speciaal van belang zijnde passages	Van belang voor conclusie nr.
A	CN 111 758 380 A (UNIV CHINA AGRICULTURAL) 13 oktober 2020 (2020-10-13) * samenvatting * * figuren 1-3 *	1-22
A	EP 0 407 322 A1 (RAFFAELLO HENRI [FR]) 9 januari 1991 (1991-01-09) * samenvatting * * figuur 3 *	14,15

Formulier PCT/ISA/201 (vervolg tweede blad) (Januari 2004)

ONDERZOEKSRAPPORT BETREFFENDE HET RESULTAAT VAN HET ONDERZOEK NAAR DE STAND VAN DE TECHNIEK VAN HET INTERNATIONALE TYPE

Informatie over leden van dezelfde octrooifamilie

Nummer van het verzoek om een onderzoek naar de stand van de techniek

NL 2028660

In het rapport genoemd octrooigeschrift	Datum van publicatie	Overeenkomend(e) geschrift(en)	Datum van publicatie
WO 2005058013 A1	30-06-2005	EP 1703786 A1	27-09-2006
		NL 1024960 C2	07-06-2005
		WO 2005058013 A1	30-06-2005
US 3353575 A	21-11-1967	GEEN	
CN 111758380 A	13-10-2020	GEEN	
EP 0407322 A1	09-01-1991	AT 103464 T	15-04-1994
		EP 0407322 A1	09-01-1991
		FR 2649287 A1	11-01-1991
		PT 94578 A	20-03-1991

WRITTEN OPINION

File No.	Filing date *(day/month/year)*	Priority date *(day/month/year)*	Application No.
SN79692	08.07.2021		NL2028660

International Patent Classification (IPC)
INV. A01D46/24 A01G3/00 A01G3/08 ADD. A01D45/00

Applicant
Saia Holding B.V.

This opinion contains indications relating to the following items:

- ☒ Box No. I Basis of the opinion
- ☐ Box No. II Priority
- ☐ Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- ☐ Box No. IV Lack of unity of invention
- ☒ Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- ☐ Box No. VI Certain documents cited
- ☒ Box No. VII Certain defects in the application
- ☐ Box No. VIII Certain observations on the application

	Examiner
	Nicolai, Sébastien

Application number

WRITTEN OPINION

NL2028660

Box No. I Basis of this opinion

1. This opinion has been established on the basis of the latest set of claims filed before the start of the search.

2. With regard to any **nucleotide and/or amino acid sequence** disclosed in the application and necessary to the claimed invention, this opinion has been established on the basis of:

   a. type of material:

   ☐ a sequence listing

   ☐ table(s) related to the sequence listing

   b. format of material:

   ☐ on paper

   ☐ in electronic form

   c. time of filing/furnishing:

   ☐ contained in the application as filed.

   ☐ filed together with the application in electronic form.

   ☐ furnished subsequently for the purposes of search.

3. ☐ In addition, in the case that more than one version or copy of a sequence listing and/or table relating thereto has been filed or furnished, the required statements that the information in the subsequent or additional copies is identical to that in the application as filed or does not go beyond the application as filed, as appropriate, were furnished.

4. Additional comments:

Box No. V Reasoned statement with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty	Yes:	Claims	2, 3, 6-9, 11-13, 18
	No:	Claims	1, 4, 5, 10, 14-17, 19-22
Inventive step	Yes:	Claims	7-9, 11-13
	No:	Claims	1-6, 10, 14-22
Industrial applicability	Yes:	Claims	1-22
	No:	Claims	

2. Citations and explanations

see separate sheet

WRITTEN OPINION

Box No. VII Certain defects in the application

see separate sheet

Re Item V

1 Reference is made to the following documents:

D1 WO 2005/058013 A1 (AGRARISCH LOONBEDRIJF C PELLIK [NL]; PELLIKAAN CORNELIS [NL]) 30 juni 2005 (2005-06-30)

D2 US 3 353 575 A (LARSON ROBERT W ET AL) 21 november 1967 (1967-11-21)

D3 CN 111 758 380 A (UNIV CHINA AGRICULTURAL) 13 oktober 2020 (2020-10-13)

D4 EP 0 407 322 A1 (RAFFAELLO HENRI [FR]) 9 januari 1991 (1991-01-09)

Independent apparatus claim 1 - patentability

2 The subject-matter of **independent apparatus claim 1** is not new, and the criteria of patentability are therefore not met.

Document **D1** (bladzijde 1, regel 5 - regel 10; bladzijde 5, regel 27 - bladzijde 6, regel 10; bladzijde 9, regel 1 - regel 22; bladzijde 10, regel 38 - bladzijde 12, regel 19; figuren 2a, 2b, 3, 10) discloses:

Oogstinrichting **10** voor het oogsten van tuinbouwproducten, zijscheuten en/of bladeren van plantstengels in de glastuinbouw, de inrichting omvattende **(*cf.* bladzijde 1, regel 5 - regel 10; figuren 2a, 2b, 3)**:

- een geleidingsorgaan **18a, 18b**, dat een doorlopende plantdoorgang definieert en dat is ingericht om de plantstengel **20** tijdens gebruik ten minste gedeeltelijk in de plantdoorgang te omringen **(*cf.* bladzijde 8, regel 1 - regel 11; figuren 2b, 3)**, en
- een snijorgaan **24**, dat is bevestigd aan het geleidingsorgaan **18a, 18b** en dat is ingericht om stelen van de producten **21**, de zijscheuten **30** en/of bladstelen van de bladeren die aan de plantstengels **20** zijn bevestigd af te snijden om ze van de plantstengels **20** te scheiden,
- waarbij de plantstengels **20** zijn ingericht om binnen het geleidingsorgaan **18a, 18b** te worden geleid bij relatieve bewegingen van de oogstinrichting langs de plantstengel **20** langs een lengteas, d.w.z. in een opwaartse verticale richting **(*cf.* bladzijde 10, regel 9 - regel 15; figur 3)**, en

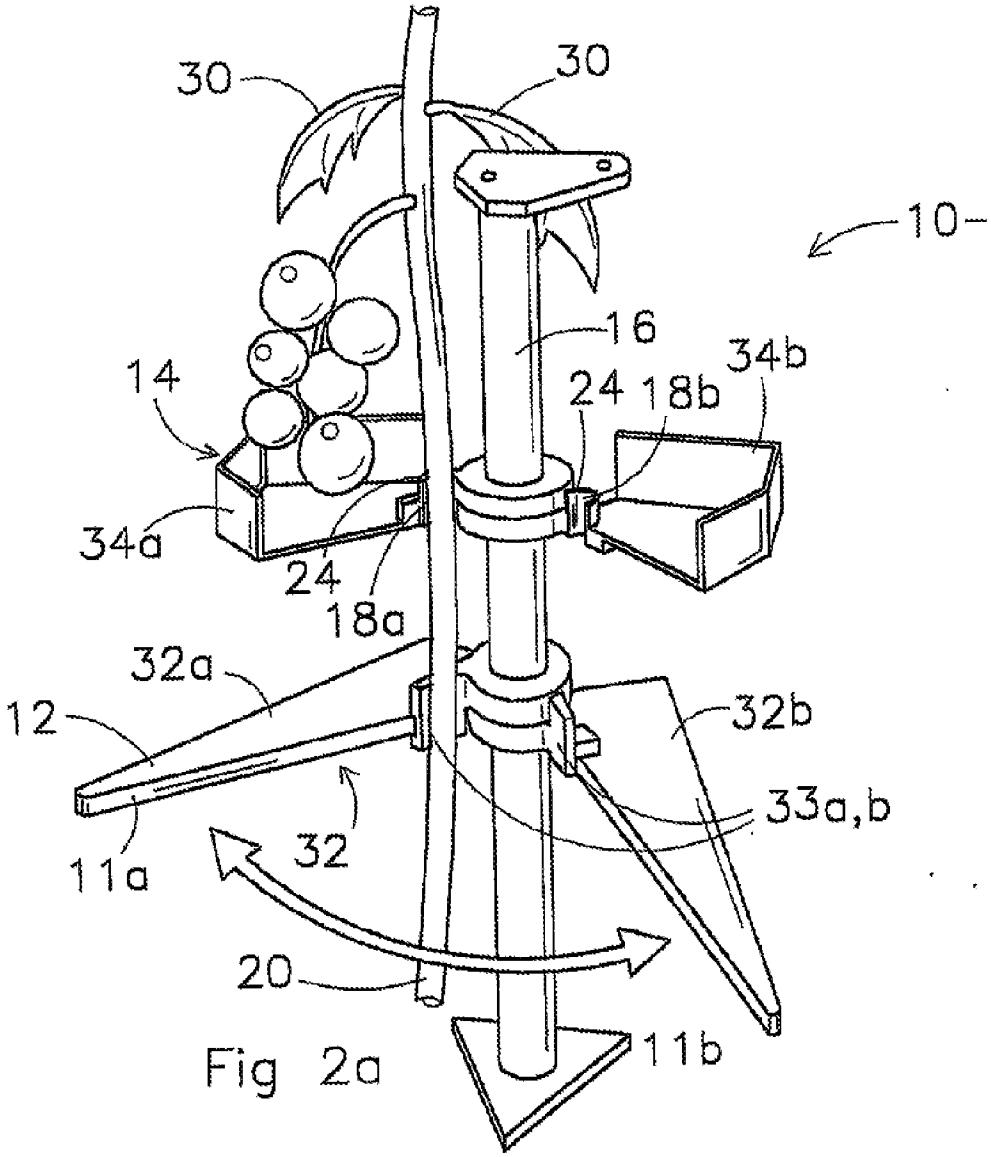


Figure 2a of WO 2005/058013 A1 (**D1**)

- waarbij het snijorgaan **20** is ingericht voor het afsnijden **(*cf.* bladzijde 10, regel 17 - regel 18)** van de stelen **21**, de zijscheuten en/of de bladstelen die door het geleidingsorgaan **18a, 18b** lopen tijdens beweging van de oogstinrichting **10 (*cf.* bladzijde 10, regel 9 - regel 15; figur 3)**, en
- waarbij de oogstinrichting **10** verder omvat een opslagorgaan **34a, 34b** dat het geleidingsorgaan **18a, 18b** ten minste gedeeltelijk omringt en dat is ingericht om de producten te verzamelen die zijn gescheiden van de plantstengels en bij voorkeur zijn ingericht om de zijscheuten en bladeren te laten vallen **(*cf.* bladzijde 11, regel 15 - regel 23; figuren 2a, 2b, 3)**.

Independent apparatus claims 14 and 15 - patentability

3 The subject-matter of **independent apparatus claims 14 and 15** is not new, and the criteria of patentability are therefore not met.

3.1 Reference is made to point 2 regarding the features of the preamble. **Independent apparatus claim 14** further specifies that:

het snijorgaan, bijvoorbeeld de snijinrichtingen, een oscillerend snijorgaan is, bijvoorbeeld een sonisch of ultrasoon snijorgaan.

This, however, is anticipated by document **D1** which discloses that »*it is also possible to design the cutting edge 24 as a plurality of driven blade parts (not shown), optionally with serrated cutting edges, which can move with respect to one another. In this way, plant parts 22 and/or 30 can be separated from the stem 20 by sawing them off the stem 2*0« (*cf.* bladzijde 9, regel 18 to regel 22).

This is considered to implicitly represent an oscillatory motion due to the relative motion of the blade parts.

Furthermore, document **D2** (* samenvatting; figuren 3, 6, 7) also discloses an apparatus in accordance with the preamble of **independent apparatus claim 1** further comprising a oscillating and/or rotating blade **136**, which is attached to the guiding structure **120**. Therefore, the subject matter of **independent apparatus claims 14 and 15** is anticipated by document **D2**.

3.2 Moreover, the subject matter of **independent apparatus claim 15** is not considered to involve an inventive step. In the light of the above, the provision of rotary cutting means represents one of only a very limited number of suitable options for designing a driven blade part and no particular technical effect, beneficial beyond the well-known advantages of this solution, can be attributed to this particular selection.

Independent method claim 21 - patentability

4 The subject-matter of **independent method claim 21** is not new, and the criteria of patentability are therefore not met.

The novelty objection (*cf.* point 2) raised with respect to the subject matter of **independent apparatus claim 1** applies, *mutatis mutandis,* to the subject matter of **independent method claim 21**. Essentially, document **D1** discloses the harvesting of horticultural produce using the apparatus according to **independent apparatus claim 1**, whereby the method steps are inherently performed.

Dependent claims 2 to 6, 10, 16 to 20 and 22 - patentability

5 **Dependent claims 2 to 6, 10, 16 to 20 and 22** do not contain any features which, in combination with the features of any claim to which they refer, meet the requirements of novelty and/or inventive step.

Document **D1** (bladzijde 1, regel 5 - regel 10; bladzijde 5, regel 27 - bladzijde 6, regel 10; bladzijde 9, regel 1 - regel 22; bladzijde 10, regel 38 - bladzijde 12, regel 19; figuren 2a, 2b, 3, 10) discloses all additional features of **dependent claims 4, 5, 10, 16 to 20 and 22**. The document also renders obvious the subject matter of **dependent claims 2, 3, 6 and 18**. Document **D1** also discloses a subdivided configuration, wherein guiding member, cutting member and storage member are subdivided (figuren 2a, 2b, 3, 10) and relatively rotatable around a rotational axis **16** extending in a parallel direction with respect to the stem **20**. This subdivision allows entry in and exit from the plant stem in the plant passage defined by the guiding member **18a, 18b**. The provision of a side aperture for providing access represents a straightforward alternative which the person skilled in the art will readily contemplate. Furthermore, document **D1** (bladzijde 14, regel 24 - regel 29) discloses a tapered surface **56** between the plant passage and the cutting blade **24** (*cf.* figure 7) to prevent that »*the stem 20 from being damaged. It also prevents the cutting edge 24 from"taking a bite"out of a stem 20*«. The optionally specified sub-range of 5 to 10 mm falls essentially within a reasonable range for the particular purpose and is anticipated by the disclosure of document **D1**, i.e. the sub-range is neither sufficiently remote from the implicitly disclosed value nor sufficiently narrow with respect to this disclosure. Document **D1** also discloses a plurality of sensors for different aspects, *inter alia,* for plant detection or assessing ripeness of the plant (*cf.* bladzijde 5, regel 27 - bladzijde 6, regel 10). The release device for separating the storage means **34a, 34b** can be considered a release device in the sense of **dependent claim 17** construed according to its broadest technically reasonable interpretation. The usage of pressurised air for cleaning the storage means is also well known in the art and does not provide any additional beneficial technical effect. This particularly applies, since document **D1** uses an air stream to clean the storage devices with the separating device **106** (*cf.* bladzijde 20, regel 1 - regel 6). Document **D1** also discloses a harvesting apparatus comprising a base and an actuator device configured to move the harvesting device relative to the base (*cf.* bladzijde 15, regel 10 - bladzijde 22, regel 10 and bladzijde 16, regel 27 - regel 34; figuren 8 and 10). An autonomous control is also suggested by document **D1** (*cf.* bladzijde 17, regel 6 - regel 9).

Dependent claims 7 to 9 and 11 to 13 - patentability

6 The subject-matter of **dependent claim7 to 9 and 11 to 13** appears patentable as it is neither known from, nor rendered obvious by, the available prior art. None of the available prior art suggests a storage member comprising a skirt surface partially tapering outwardly in the radial direction. The same applies to the crown-shaped guiding member.

Industrial applicability of claims 1-22

7 The industrial applicability of the claimed subject-matter of **claims 1 to 22** is beyond doubt.

Re Item VII

General annotations

8 The application does not fulfill formal requirements. The applicant is invited to consider the following points:

The **relevant background art** disclosed in documents **D1-D4** is not mentioned in the description, nor are these documents identified therein. **The applicant should ensure that it is clear from the description which features are already known from the closest prior art**.