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(54) Benævnelse: **ANORDNING OG FREMGANGSMÅDE TIL FREMME AF PLANTERS VÆKST**

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Description

[0001] The invention relates to a device for automatically breeding plants, which comprises a conveyor belt that can move along a conveyor section in order to at least transport plants in sections. During the transportation of the plants along the conveyor section that runs at least approximately horizontally in at least one first section and runs at least approximately vertically in at least one second section, the plants are supplied, at least intermittently, with water and culture medium by a nutrient supply unit.

[0002] Hydroponic and aeroponic plant breeding have been known for many years, these having become intensively used cultivation systems, above all for greenhouse crops such as tomatoes, cucumbers and lettuces, especially in recent decades. The mass production of agricultural products in fully air-conditioned buildings under strict control of external influences is also referred to as “indoor farming”.

[0003] In this connection, systems are known for breeding plants, in which the plants are arranged in a shelving system and automatically supplied with a culture medium during the growth phase. Such a system is described in JP 2014-168420 A, for example, wherein in this document the plants intended to be bred are arranged in a horizontal plane, each fixed in a substrate, and are supplied with water and nutrients by regularly flooding and draining culture medium. In addition, artificial lighting is provided by means of fluorescent tubes or LEDs mounted directly above the plants.

[0004] Furthermore, a special greenhouse is known from AT 250728, which is designed as a tower greenhouse. It is essential here to utilize the height of a building to create a conveyor section for breeding the plants. The greenhouse described comprises a plurality of conveyor belts arranged in a serpentine shape for transporting the plants, wherein the conveyor belt is designed as a circumferential section and comprises upper and lower idler pulleys such that the plants can be moved vertically in different directions. In order to ensure effective illumination, suitable fluorescent tubes are provided between the vertically arranged conveyor belts.

[0005] Another technical solution for automatically breeding plants is described in US 2012/0279122 A1. The system described comprises a conveyor belt, which is arranged in a serpentine shape and part of which runs in the vertical direction. Corresponding idler pulleys are provided for changing the direction of the conveyor belt. Furthermore, special containers are provided for transporting the plants, which contain substrate for receiving seeds or plants and which hook into the revolving conveyor belt by means of special hook elements. The described

containers for receiving the plants extend over the entire width of the conveyor belt in this case and can each receive a plurality of plants next to one another.

[0006] Furthermore, WO 2010/008335 describes a system for automatically breeding plants, in which the plants are arranged in plant breeding containers while being constantly vertically oriented and are conveyed from the bottom up and from the top down on section sections running obliquely. The plants are illuminated by means of an illumination apparatus as they are moved, wherein the individual lighting elements are arranged such that the plants are illuminated along the entire conveyor section. In order to achieve as optimum illumination as possible, the lighting elements are also arranged inside the V-shaped conveyor section.

[0007] Furthermore, US 2009/165373 A1 describes a device in which the plants are arranged on mounting rails, intended for said plants, on a rotating drum. The plants are oriented such that they face the interior of the drum with their leaves and therefore the plants are sometimes conveyed suspended overhead as they are moved. The plants are hydroponically supplied with culture medium in the lower area of the drum.

[0008] A device for automatically breeding plants, which comprises a conveyor belt guided by means of deflection points, is known from EP 2 489 256 A2. In this case, the main part of the conveyor belt is arranged in horizontally running transport sections that lie one above the another in parallel, while a movement takes place in the vertical direction in the area of the idler pulleys between two sections of the conveyor belt that are arranged horizontally above one another and on a section on which the plants are conveyed between the uppermost and the lowermost horizontal conveyor belt section, in sections. The conveyor section is arranged inside a greenhouse and the plants are illuminated by sunlight shining in from the outside, which is extensively deflected by means of a reflector.

[0009] Despite the increased energy requirement, the known automated systems for breeding plants have a number of advantages over conventional agriculture in fields. In addition to being entirely non-weather-dependent, the climatic conditions inside the greenhouse can be optimally adapted to the respective plants the entire time and constant plant growth can therefore be achieved. In addition, on account of specific water recovery systems, considerably less water is required for breeding the plants than when cultivating fields outdoors. In addition, comparatively less fertilizer is required and breeding plants in fully air-conditioned spaces makes it possible to grow plants without pesticides.

[0010] When using vertically arranged conveyor sections, the advantage of substantially better utilization of the area available is also achieved. This is largely advantageous especially in

industrialized countries that have a comparatively small proportion of areas suitable for agriculture, such as Japan.

[0011] The problem with the known systems for automatically breeding plants in fully air-conditioned spaces is often that the systems used are relatively complex to adapt to different plants. When changing the plants that are grown, consideration needs to be taken of the fact that the size of different plants during the growth phase changes to varying degrees and in different time periods. Adapting the known systems for automatically breeding plants to the different conditions is difficult. Furthermore, supplying the plants with the required nutrients and water without damaging the leaves or roots is regularly a problem.

[0012] Proceeding from the systems known in the art for automatically breeding plants and the problems explained above, the object of the invention is to provide a plant breeding system that allows for the simple breeding of crop plants and ornamental plants, which is adapted to the plant growth phase and is preferably implemented in enclosed spaces. The technical solution to be provided is in particular intended to provide a comparatively simple way of providing an almost complete automation of the plant breeding process, from depositing a seed up to harvesting the fully mature plant. Furthermore, it is to be ensured that the water and nutrient requirement can be limited to a minimum. In this case, the device designed according to the invention is intended to be characterized by a simple structural design, which can preferably be achieved using the system components known for the construction of automatic greenhouse systems.

[0013] The above problem is solved by means of a device for automatically breeding plants according to claim 1. A method for breeding plants, which is used by the invention, is indicated in claim 12. Advantageous embodiments of the invention form the subject matter of the dependent claims and are explained in more detail in the following description, with reference in part to the drawings.

[0014] The invention relates to a device for encouraging the growth of plants, in particular for automatically breeding plants, comprising a conveyor belt that can move along a conveyor section in order to at least transport plants in sections. As they are moved along the conveyor section, the transported plants are at least intermittently supplied with nutrients and water by a nutrient supply and, as they are conveyed along the conveyor section, are moved at least approximately horizontally in at least a first section and at least approximately vertically in at least a second section. In this case, the plants are at least temporarily fixed relative to the conveyor belt when being transported along the conveyor section such that roots of the plants at least sometimes extend inward into an area arranged underneath an underside of the conveyor belt, while leaves and/or fruits of the plants at least sometimes extend inward into an area

arranged above an upper side of the conveyor belt, which is located opposite the underside. The invention is characterized in that the illumination can be adapted both to the species of plant to be bred and/or to the plant growth and can be done at any point, when necessary, and in that the device is produced by assembling at least two pre-grouped modules, wherein one module is formed by at least one subportion of the conveyor section running approximately vertically from the bottom up and a subportion of the conveyor section running at least approximately vertically from the top down and, on the basis of the plant to be bred, a plurality of modules required for implementing a vegetative phase of the plant are connected to one another by means of interface elements. In this connection, essential features of the invention are that the plants are fixed to the conveyor belt during their growth phase, are continuously moved in the vertical direction and are transported toward a light source, at least intermittently, and the root area is continuously supplied with a nutrient solution. Due to the specific arrangement of the conveyor section having section sections running at least approximately vertically in the upward and downward direction, the plants are exposed to constant orbitropic reorientation, which encourages plant growth.

[0015] In a specific embodiment of the invention, the conveyor belt, at least in some areas, contains a substrate in which the plants are at least temporarily fixed when being transported along the conveyor section. The substrate is preferably selected such that the seeds or plants are securely held, and the material can also transfer and store, at least temporarily, water and/or culture medium. Since the device designed according to the invention at least transports the plants in sections in the approximately vertical direction, according to a particular development of the invention, it is possible for the plants to be continually directed in the vertical direction to an illumination source during their growth please and the root area arranged on the bottom of the conveyor belt is simultaneously aeroponically supplied with nutrients and moisture in this case. In this connection, it is conceivable for an upper deflection point to be provided between two vertically running sections of the conveyor section such that the plants are moved upward in the vertical direction together with the conveyor belt and then, after circulating the deflection point, are moved downward in the vertical direction.

[0016] In general, it is conceivable for natural light or light generated artificially by means of an illumination unit, which comprises at least one fluorescent tube and/or one LED, for example, to be used to illuminate the plants. The provision of an illumination unit for generating light is advantageous here in that, according to the invention, the plants can be illuminated in a targeted manner and when necessary, in particular adapted to the species of plant to be bred and/or tailored to the plant growth, at any point.

[0017] According to a specific development, the illumination unit is furthermore designed such that the plants are illuminated in targetedly selected sections of the conveyor section. The plants are advantageously illuminated while they are continuously moved upward on a vertically arranged section of the conveyor section. Furthermore, it is advantageous for the plants to no longer be illuminated, at least temporarily, after circulating the deflection point, in particular as they are moved downward in the vertical direction.

[0018] In a particularly advantageous embodiment, the plants fixed on the conveyor belt, in particular the roots beneath the conveyor belt, are aeroponically supplied with culture medium as they are moved in the vertical direction, while, in the area of a lower deflection point arranged between two vertically running subportions of the conveyor section, they are moved, at least in part, through a dipping bath, and therefore the plants, in particular the roots, are hydroponically supplied with nutrients in this area. In this way, the plants are continuously supplied with nutrients and moisture along the serpentine or meander-shaped conveyor section, which has vertically running section sections, between which lower and upper deflection points or areas are arranged. A culture medium nebulization system is preferably used to aeroponically irrigate the roots of the plants. By means of an automatic system for breeding plants designed as described above, it is preferably possible to provide continuous aeroponic irrigation of the roots on the bottom of the conveyor belt, while the plant substrate is hydroponically bathed in the area of the lower deflection points as it passes along the trough phase of the conveyor belt.

[0019] In this case, by fixing the plants on the conveyor belt, permanent aeroponic irrigation, or aeroponic irrigation that at least lasts for long periods of time, takes place without the leaves of the plants unnecessarily getting wet. In this way, leaf mass diseases are reliably prevented. The atmosphere, in particular in the vertical conveyor section sections below the conveyor section, is monitored by means of a sensor system with respect to the temperature and air moisture and the values are suitably controlled by closed-loop control by means of a central control unit such that too high air moisture in this area can be reliably avoided.

[0020] The conveyor section is advantageously dimensioned and/or the speed of operation of the conveyor belt is set such that a single upward and downward movement of the conveyor section by means of a change of direction together with the simultaneously dampening of the root area on the underside is designed as one module, wherein such a cultivation loop is preferably run through in 24 hours.

[0021] By means of the module-like structure provided according to the invention, it is possible to adapt a complete system for automatically breeding plants to the respective needs, i.e. the plants to be cultivated and/or the particular vegetative phase. By making the conveyor belt longer

by stringing modules together, a complete vegetation period of a crop plant can easily be provided, wherein each module is adapted to the needs of the growth stage of the respective plants in terms of illumination and space needed. For this reason, according to a preferred design based on the invention, the individual modules or sections of the conveyor section together with the conveyor belt are designed such that in particular the length of the lower sections arranged between two vertically running section sections can be changed. Once a plurality of modules are assembled to form an overall system, it makes sense for the distances between a section section running downward approximately vertically and a section section running upward approximately vertically to become larger as the transportation time of the plants increases, and therefore the distances are adapted to the plant growth. By targetedly varying the distance between the vertically running sections, it is therefore possible to adapt the distance to the particular size of the plants fixed on the conveyor belt.

[0022] Furthermore, alternatively or in addition to the above-described embodiment, it is advantageously conceivable to adapt a device for automatically breeding plants to the size requirement of the respective plants by changing the spacing between the points where the individual plants are fixed on the conveyor belt. Mechanical elements are preferably provided for this purpose, which ensure that the distance between the individual fixing points is set according to needs. Therefore, it is conceivable, for example, for the individual fixing points to be moved further apart as the transportation time of a plant and the plant growth associated therewith increases, wherein latching positions are conceivable in different places. By adapting the conveyor section or the conveyor belt to the changing size of the plants in this way, on the one hand the increasing space requirement of the plant is taken into account and, on the other hand, the use of material and energy is minimized. In this way, the system is operated in a particularly effective manner from an economical and an ecological point of view, since the effort for irradiating and illuminating the plants during the seedling stage is considerably reduced, for example.

[0023] According to another specific design of the device designed according to the invention, an illumination unit is provided, which allows for targeted and controlled irradiation of the plants with suitable wavelengths. It is, in turn, also conceivable in this case to adapt the illumination to the respective requirements of the plants or the different growth phases. In this way, the illumination of the plants is targetedly adapted to the plant growth. According to another embodiment, the device is designed such that both illuminated and non-illuminated sections of the conveyor section are provided.

[0024] Furthermore, the device according to the invention for automatically breeding plants preferably comprises a pick-and-place system, by means of which the conveyor belt and/or the substrate provided on the conveyor belt is/are automatically populated with at least one seed and/or with a seedling. It is likewise conceivable for a harvesting module to be provided in one area of the conveyor belt, by means of which the plant that has grown to the desired extent, in particular the leaves and/or the fruit, can be removed. More preferably, the device designed according to the invention comprises a section, preferably arranged downstream of the harvesting module, in which the conveyor belt is cleaned and/or sterilized.

[0025] A device according to the invention is preferably designed such that its own pick-and-place unit and a harvesting unit are provided, between which a cleaning and/or a sterilizing system, in particular a steam sterilization system, is provided in the direction of movement of the conveyor belt such that the conveyor belt is cleaned and/or sterilized after the plants grown have been harvested or before carrying out a new picking and placing process.

[0026] With regard to fixing the plants in or on the conveyor belt, it is in principle conceivable for the seeds and/or seedlings to be directly fixed in or on the conveyor belt or indirectly fixed therein or thereon by means of a substrate. According to an alternative embodiment, the conveyor belt comprises suitable plant containers, which can be populated with plants and which are fastened to the revolving conveyor belt by means of fastening elements. In this connection, it is conceivable for the conveyor belt to comprise at least one conveyor chain, for example, into which a hook of the plant container, which is used as a fastening element, can hook once a plant is intended to be transported along the conveyor section. If plant containers that can be connected to the conveyor belt are accordingly used, they are preferably released from the conveyor belt or the conveyor chain for the harvesting process, cleaned once the harvesting process has finished and lastly resupplied to the pick-and-place system. After being populated with a seed or a seedling, corresponding plant containers in turn hook into the conveyor belt or conveyor course at the beginning thereof.

[0027] In addition to a specific device for automatically breeding plants, the invention further relates to a method for automatically breeding crop plants or ornamental plants.

[0028] An essential part of the method designed according to the invention is that the plants are transported in a manner rigidly fixed on or to the conveyor belt and are subjected to continuous orbitropic reorientation by the at least temporary and at least approximately vertical transportation in conjunction with a change of direction at upper and lower deflection points. By guiding the plants such that they are fixed, it is also comparatively simple to ensure permanent

aeroponic irrigation without unnecessarily dampening the leaf proportion of the plants. For this reason, diseases of the leaf mass can be largely avoided.

[0029] The type of spatial separation between the leaves and the root area also allows for an atmosphere that can be controlled by means of open-loop control and closed-loop control more effectively and too high air humidity can be reliably avoided.

[0030] A particular advantage of the invention also consists in the possibility of adapting the conveyor section or the conveyor belt to the size of the plants. This is preferably done by mechanically spreading the conveyor belt apart in the area of the fixing points and/or the distances between individual cultivation modules in order to meet the increasing space requirement of the growing plants being bred. By means of an illumination and irrigation regimen that is optimized in terms of the modified distances between the plants, considerable savings can be made with regard to installation and energy consumption. By means of the device according to the invention, which preferably provides a modular stringing together of cultivation modules implemented in the form of a loop in the vertical direction, particularly flexible and also economical plant breeding is possible, which is adapted to the plants and the growth stage of the plants. Furthermore, by combining it with an automatic pick-and-place and/or harvesting unit at the start or end of the conveyor section, considerable savings can advantageously be made in terms of costs.

[0031] In the following, the invention will be explained in more detail on the basis of embodiments and with reference to the drawings, without limiting the general concept of the invention. In the drawings:

Fig. 1 is a schematic view of a device designed according to the invention for automatically breeding plants, and

Fig. 2 is a plan view of a conveyor belt suitable for a device for automatically breeding plants.

[0032] Fig. 1 is a schematic view of a device designed as per the invention for automatically breeding plants. An essential part of this device is that the plants 8 are fixed on the conveyor belt 2 as they are transported along the conveyor section 1, wherein the roots of the plants 8 are at least largely arranged on a different side of the conveyor belt 2 to the leaves. The dimensions of the conveyor section 1 and the speed of operation of the conveyor belt 2 are selected such that the amount of time for which the plants 8 are moved along the conveyor section 1 from when a seed or seedling is deposited on the conveyor belt 2 to when it is removed from the conveyor belt 2 corresponds to a vegetative phase of the corresponding plant 8.

[0033] With regard to the arrangement of the conveyor section 1, it is especially important for the plants 8 fixed on the conveyor belt 2 to each be moved vertically, in sections, both in the upward and in the downward direction while said plants are moved in the horizontal direction, at least temporarily, in particular in the area of the upper and lower deflection points 4, 5 between the individual vertical section sections 6.

[0034] At the beginning of the conveyor section 1, a pick-and-place unit 12 is provided, by means of which receiving elements 3 of the conveyor belt 2 are each populated with a seedling 8. The receiving elements 3 according to the embodiment described each comprise a substrate 18, in which the plant 8, in particular its roots, are fixed. It is essential for the roots of the plants 8 to be arranged in an area 19 beneath the conveyor belt 2, while the leaves extend in an area 20 above the conveyor belt 2. The areas 19, 20 in which the roots on the one hand and the leaves on the other hand are arranged are thereby spatially separated from one another. Furthermore, the roots are arranged in a ventilated space as the plants 8 are moved on the vertical sections 6 of the conveyor section 1, in which space the plants 8 are aeroponically dampened and supplied with nutrients 9a.

[0035] Due to the specific design of the conveyor section 1, the plants 8 together with the conveyor belt 2 are each alternately moved in the vertical direction up to an upper deflection point 4 and then, in turn, downward toward a lower deflection point 5 moved. Once the plants 8 reach the lower end of the vertical section 6, they are moved in the horizontal direction, at least along a short section section 7. During this movement in the area of the lower deflection point 5, the substrate together with the roots of the plants 8 arranged therein is submerged in a dipping bed 9b such that the plants 8 are hydroponically dampened and supplied with nutrients. Following this at least brief horizontal movement, the plants 8 are, in turn, moved along the next two vertical section sections 6 of the conveyor section 1, having the upper deflection point 4 arranged therebetween. While the plants 8 are moved along these vertically arranged section sections 6, the plant roots are, in turn, aeroponically dampened 9a on the bottom of the conveyor belt 2.

[0036] A section of the conveyor section 1, which consists of two vertical sections 6, in which the plants 8 are moved from the bottom up and then from the top down, and a deflection point 5 arranged between the vertical sections, is characterized as a module or a cultivation module. In this case, a module is designed, and the speed of the conveyor belt 2 is set, such that the plants 8 traverse such a module within 24 hours. An overall system is, in turn, made up of the required number of modules such that a complete growth phase of the respective plants 8 can be achieved.

[0037] Furthermore, the device for automatically breeding plants comprises an illumination unit 10, which is designed such that the plants 8 are sometimes illuminated with artificially generated light and are sometimes not illuminated as they move along the conveyor section 1. In the embodiment shown in Fig. 1, the plants 8 are always illuminated as they move downward along a vertical section section 6 between the upper 4 and the lower 5 deflection points. In contrast, as the plants 8 move along a section section running from the bottom up, a shading phase 11 is provided. In this case, the illumination unit 10 is covered such that the plants 8 are not illuminated. In principle, it is conceivable to adapt the type, intensity and duration of the illumination to the particular species of plant. In any case, the illumination is controlled or is suitably regulated by means of sensors and a control unit. In the embodiment shown in Fig. 1, 10 LED panels are provided as the illumination unit, each of which are arranged opposite the vertical section section 6 that runs in the downward direction.

[0038] Furthermore, the device shown in Fig. 1 for automatically breeding plants comprises an adjustment unit 21 such that the distance between the individual modules, which consist of two vertical section sections 6 and an upper deflection point 4 arranged therebetween, can be adapted to the increase in size of the individual plants 8. As can be clearly seen in Fig. 1, the size of the plants 8 increases as they are transported along the conveyor section 1. To the extent that the plants 8 grow, the distance between the individual modules increases on the one hand and, on the other hand, the illumination is adapted to the modified illumination requirement caused by the increased green proportion of the plants 8. In addition to these measures, the conveyor belt 2 is also designed such that the distance between the individual receiving elements 3, in which each of the plants are fixed, can be changed on the basis of the plant growth. A particular embodiment of a conveyor belt 2 that can be adapted to the increase in size of the plants is explained in connection with Fig. 2.

[0039] An automatic harvesting unit 13 is provided at the end of the conveyor section 1, which removes the plants 8, which have now grown to normal size, from the revolving conveyor belt 2. Immediately after the harvesting unit 13, the conveyor belt 2 in turn changes direction and lastly runs back to the pick-and-place unit 12. In order to ensure the required cleaning and sterilization of the conveyor belt 2, the conveyor belt 2 is firstly cleaned along the section between the harvesting unit 13 and the pick-and-place unit 12 and lastly sterilized by means of a steam sterilization system 14. The conveyor belt 2 therefore arrives back at the pick-and-place unit 12 fully cleaned and sterilized, by means of which pick-and-place unit the individual receiving elements 3 of the conveyor belt 2 are repopulated with substrate 18, at least provided this is not reusable, and with seeds or seedlings 8.

[0040] As shown in Fig. 1, it is advantageous for the individual receiving elements 3 to firstly be populated with substrate 18, provided this is not reusable, and with a seed or a seedling 8 either in the pick-and-place unit 12 or in an upstream processing step such that the already populated receiving elements 3 can be attached or fastened to the conveyor belt 2.

[0041] However, it is generally also conceivable for the receiving elements 3 to be integrated in the conveyor belt 2 or at least rigidly connected thereto such that the pick-and-place unit 12 only introduces a seed or a seedling 8 and, if necessary, new substrate 18, into the receiving elements 3.

[0042] In both cases, it is possible for the receiving elements 3 to already comprise substrate 18 in which seeds or seedlings 8 can be introduced by means of the pick-and-place unit 12 or for the individual receptacles 3 of the conveyor belt 2 to be populated with a seed or a seedling 8, the roots of which are already arranged in the substrate 18.

[0043] Fig. 2 is a plan view of a cutout of a conveyor belt 2, which can be adapted to the growth of the plants 8 as they are conveyed along the conveyor section 1. A corresponding adjustment to the distance between the individual receiving elements 3 would make sense since, as the growth of the plants 8 increases, the leaf proportion, for example in lettuce heads, in particular increases and the space needed of the individual plants 8 therefore also increases. For this reason, the individual receiving elements 3 of the conveyor belt 2 are suitably moved further apart by means of mechanical elements such that the individual plants 8 have more space or room for their growth and the plants are sufficiently illuminated.

[0044] The above-described adaptation is substantially achieved by the distance between the receiving elements 3, in each of which a plant 8 or the roots thereof is/are fixed in the substrate 18, being modified on the basis of the amount of time the plants 8 are on the conveyor belt 2. Taking the extent and the speed of the plant growth into account, the distances between the individual receptacles increases as the plants 8 are transported. For this purpose, Fig. 2 shows a cutout of a conveyor belt 2 comprising plants 8 fixed thereto in two different growth stages of the plants 8 in each case. While the plants 8 shown in Fig. 2a) are still at the beginning of the conveyor section 1 and are comparatively small, in the state shown in Fig. 2b), they are already very close to being harvested and have therefore reached a corresponding size. In order to take this increase in size into account, the distances between the individual receiving elements 3 are considerably greater in Fig. 2b) than the corresponding distances in Fig. 2a).

[0045] In the embodiment shown in Fig. 2, the conveyor belt 2 comprises conveyor chains 15, to which the individual plant receptacles 3 are fastened by means of suitable elastic 16. The belts 16 are designed such that both the distance “A” between the parallel belts 16 and the distance

"B" between each of the receiving elements 3 fastened to a belt 16 can be changed. While the distance "A" is changed by the belts 16 moving outward, the distances "B" between the individual receptacles 3 are changed by the belts 16 elastically stretching in the longitudinal direction. Likewise, the distances from the receiving elements 3 that are not directly connected to the belts 16 are increased by resilient connecting elements 17 being provided between the receiving elements 3, which connecting elements are correspondingly stretched when the belts 16 are adjusted.

[0046] The receptacles 3 can be fastened to the belts 16 by hooking at least some of the receptacles 3 into the belts 16. It is likewise conceivable for at least some of the receptacles 3 to be rigidly connected to a belt 16 in each case.

[0047] As can be seen from Fig. 2, however, not all receptacles 3 have to be directly connected to a belt 16, but can also be indirectly connected by other receptacles 3 to at least one belt 16 by means of resilient connections 17. As the transportation time of the plants 8 increases, the belts 16 are moved apart on the one hand and stretched in the longitudinal direction on the other hand such that the distances between the receptacles 3 together with the plants 8 arranged therein increase. In this connection, it is likewise conceivable for elastically stretchable elements 17 to only be provided between the individual receiving elements 3 and for only the outer receptacles 3, specifically the receptacles 3 arranged at each of the corners in Fig. 2, to be pulled outward. Equally, the receptacles 3 could be arranged at different points of a resilient network or a corresponding resilient network could form at least part of the conveyor belt 2, wherein the network can be spread out as needed, in particular depending on the plant growth, in order to change the distances between the receptacles 3 as needed.

[0048] Furthermore, it is conceivable for the individual receptacles 3 not to be moved as a result of the movement of resilient connecting elements 17, but for it to be possible to actively move the receptacles 3 individually.

Lift of reference numerals

[0049]

1	conveyor section
2	conveyor belt
3	receptacle
4	upper deflection point
5	lower deflection point
6	vertical section section
7	horizontal section section
8	plant
9	nutrient supply unit
	9a aeroponic nutrient supply unit
	9b hydroponic nutrient supply unit
10	illumination unit
11	shading phase
12	pick-and-place unit
13	harvesting unit
14	cleaning and sterilization unit
15	conveyor chain
16	belt
17	resilient connecting elements
18	substrate
19	area underneath the conveyor belt
20	area above the conveyor belt
21	adjustment unit

Patentkrav

1. Anordning til fremme af planters (8) vækst med et fremføringsbånd (2), der kan bevæges langs en fremføringsstrækning (1), til mindst afsnitsvis transport af planter (8), som under bevægelse langs fremføringsstrækningen (1) i det mindste indimellem forsynes med næringsstoffer af en næringsstofforsyning (9) og bestråles af en belysningsenhed (10), hvor fremføringsstrækningen (1) i mindst et første afsnit (7) er anbragt i det mindste omtrent horisontalt og i mindst et andet afsnit (6) er anbragt i det mindste omtrent vertikalt,

hvor planterne (8) i det mindste indimellem under transporten langs fremføringsstrækningen (1) er fastgjort sådan i forhold til fremføringsbåndet (2), at planternes (8) rødder i det mindste delvist strækker sig ind i et område (19) anbragt under en underside af fremføringsbåndet (2), mens planternes (8) blade og/eller frugter i det mindste delvist strækker sig ind i et område (20) anbragt over en overside af fremføringsbåndet, som ligger modsat undersiden,

hvor belysningsenheden (10) er udført sådan, at belysningen kan tilpasses både til den planteart, der skal dyrkes, og/eller til plantevæksten, og også kan ske ved behov til enhver tid, **kendetegnet ved, at** anordningen er fremstillet ved samling af mindst to forgrupperede moduler, hvor et modul udgøres af et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt nedefra og op, og et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt oppefra og ned, og afhængigt af den plante, der skal dyrkes, et nødvendigt antal moduler til realisering af en vegetationsfase for planten er forbundet med hinanden via grænsefladeelementer.

2. Anordning ifølge krav 1,
kendetegnet ved, at fremføringsbåndet (2) mindst områdevist har et bæremateriale (18), i hvilket planterne (8) i det mindste indimellem er fastgjort under transporten langs fremføringsstrækningen (1).

3. Anordning ifølge krav 1 eller 2,
kendetegnet ved, at fremføringsstrækningen (1) har et nedre styrepunkt (5) mellem to i det mindste omtrent vertikalt anbragte delafsnit (6).

4. Anordning ifølge et af kravene 1 til 3,
kendetegnet ved, at fremføringsstrækningen (1) har et øvre styrepunkt (4) mellem to i det mindste omtrent vertikalt anbragte delafsnit (6).

5. Anordning ifølge et af kravene 1 til 4,
kendetegnet ved, at der er tilvejebragt en i det mindste delvist automatiseret monteringsenhed (12), som monterer plantefrø og/eller kimplanter (8) på fremføringsbåndet (2).

6. Anordning ifølge et af kravene 1 til 5,
kendetegnet ved, at næringsstofforsyningen (9) i området (19) under undersiden af fremføringsbåndet har en forsyningsenhed (9) til aeroponisk forsyning af planterne (8) med næringsstoffer, som udbringer et næringsmedium som en tåge og/eller i retning af undersiden af fremføringsbåndet.

7. Anordning ifølge et af kravene 1 til 6,
kendetegnet ved, at næringsstofforsyningen (9) har mindst et dyppebad (9b) med næringsopløsning, som i det mindste planternes (8) rødder i det mindste afsnitsvist føres gennem langs fremføringsstrækningen (1).

8. Anordning ifølge et af kravene 1 til 7,
kendetegnet ved, at der er tilvejebragt mindst en justeringsenhed (21) til at ændre en afstand mellem et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt oppefra og ned, og et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt nedefra og op.

9. Anordning ifølge krav 1,
kendetegnet ved, at mindst en belysningsenhed (10) er integreret i modulet, og/eller at to moduler er forbundet via et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent horisontalt, og hvis længde vælges afhængigt af den plante, der skal dyrkes.

10. Anordning ifølge et af kravene 1 til 9,
kendetegnet ved, at der er tilvejebragt en i det mindste delvist automatiseret høstenhed (13), som fjerner planterne (8) i det mindste delvist fra fremføringsbåndet (2).

11. Anordning ifølge et af kravene 1 til 10,
kendetegnet ved, at der i et område af fremføringsstrækningen (1), som ligger mellem et område, i hvilket planterne i det mindste delvist fjernes fra fremføringsbåndet (2), og et område, i hvilket plantefrø og/eller kimplanter (8) fastgøres på fremføringsbåndet (2), er anbragt en rengørings- og/eller sterilisationsenhed (14) til rengøring og/eller sterilisation af fremføringsbåndet (2).

12. Fremgangsmåde til fremme af planters (8) vækst, hvor planterne (8) bevæges med et fremføringsbånd (2) langs en fremføringsstrækning (1), under bevægelsen langs fremføringsstrækningen (1) i det mindste indimellem forsynes med næringsstoffer af en næringsstofforsyning (9) og bestråles af en belysningsenhed (10), hvor planterne (8) i mindst et første afsnit (7) af fremføringsstrækningen (1) bevæges i det mindste omtrent i horisontal retning og i mindst et andet afsnit (6) af fremføringsstrækningen (1) bevæges i det mindste omtrent i vertikal retning,

hvor planterne (8) i det mindste indimellem under transporten langs fremføringsstrækningen (1) fastgøres sådan i forhold til fremføringsbåndet (2), at planternes (8) rødder i det mindste delvist strækker sig ind i et område (19) anbragt under en underside af fremføringsbåndet, mens planternes blade og/eller frugter i det mindste delvist strækker sig ind i et område (20) anbragt over en overside af fremføringsbåndet, som ligger modsat undersiden,
hvor planterne (8), der bevæges langs fremføringsstrækningen (1) belyses sådan, at belysningen både tilpasses til den planteart, der skal dyrkes, og/eller til plantevæksten, og/eller ved behov sker til enhver tid, **kendetegnet ved, at** der afhængigt af den plante, der skal dyrkes, anbringes et antal af mindst to moduler, som er nødvendige til realisering af en vegetationsfase for planten, efter hinanden, hvilke hver især udgøres af et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt nedefra og op, og et delafsnit af fremføringsstrækningen (1), der forløber i det mindste omtrent vertikalt oppefra og ned.

13. Fremgangsmåde ifølge krav 12,
kendetegnet ved, at planterne (8), mens de bevæges i det mindste omtrent vertikalt, forsynes i det mindste indimellem aeroponisk med vand og/eller næringsstoffer.

14. Fremgangsmåde ifølge krav 12 eller 13,

kendetegnet ved, at planterne (8), mens de bevæges i det mindste tilnærmelsesvist horisontalt, forsynes i det mindste indimellem hydroponisk med vand og/eller næringsstoffer.

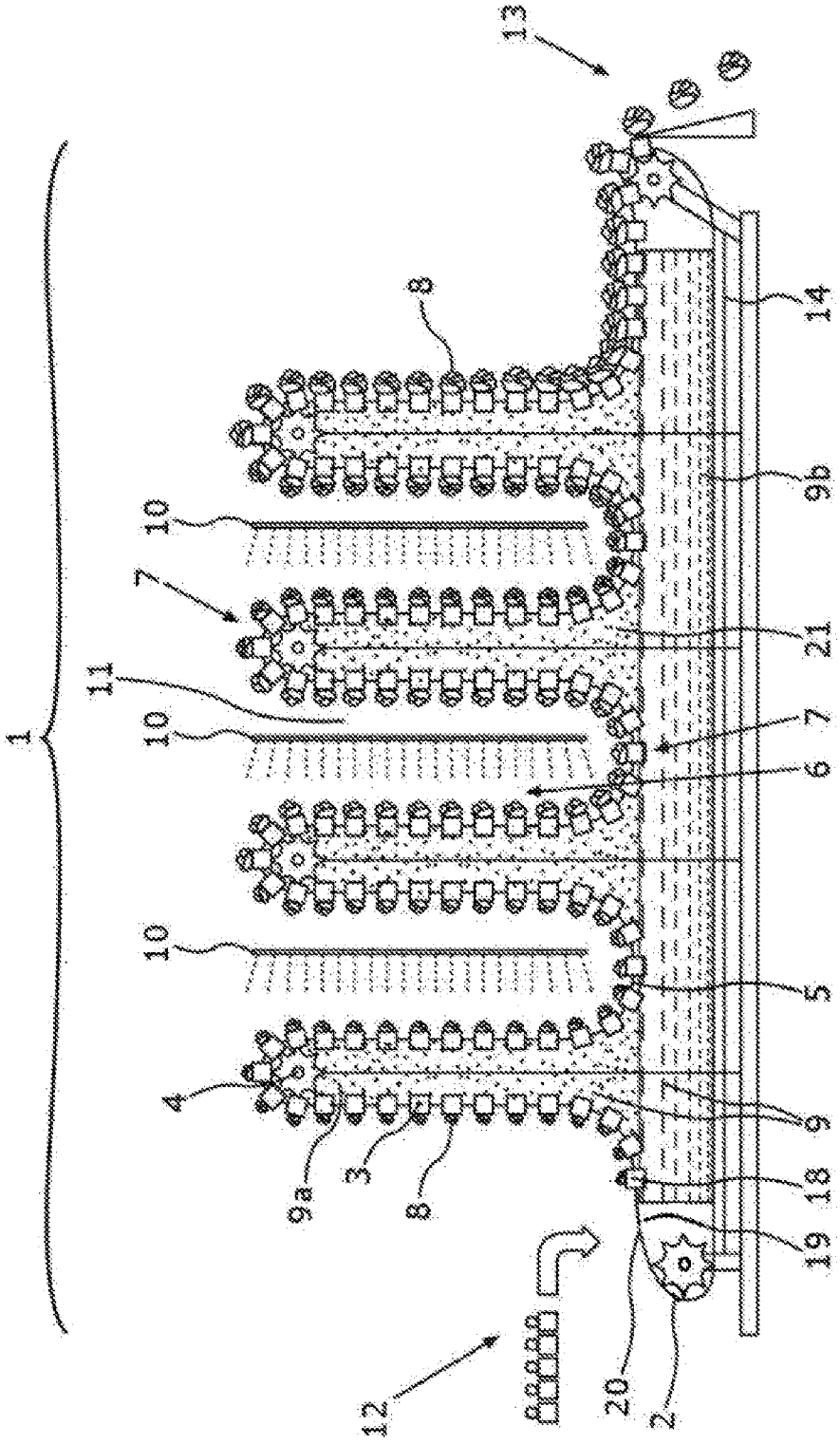

Fig. 1

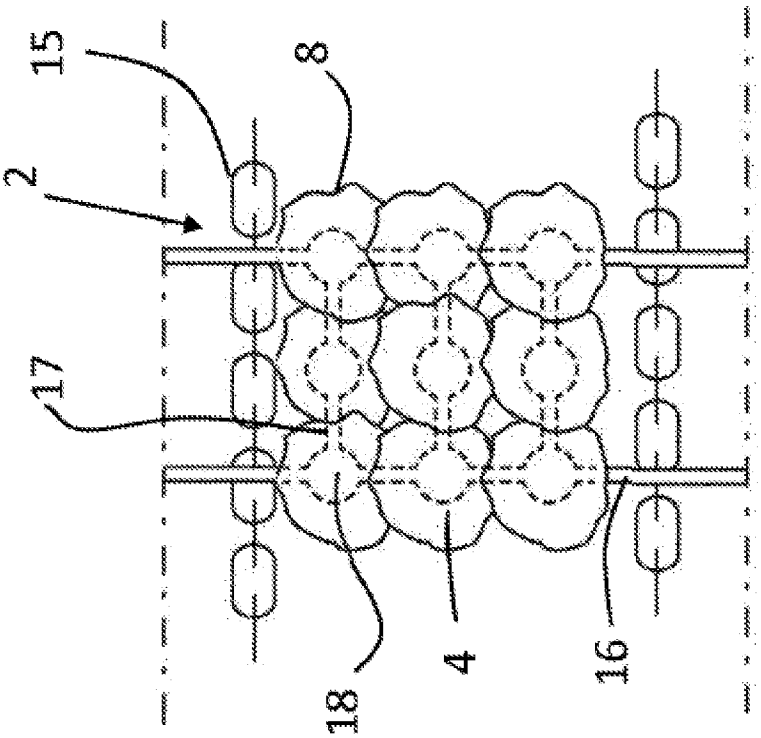

Fig. 2b

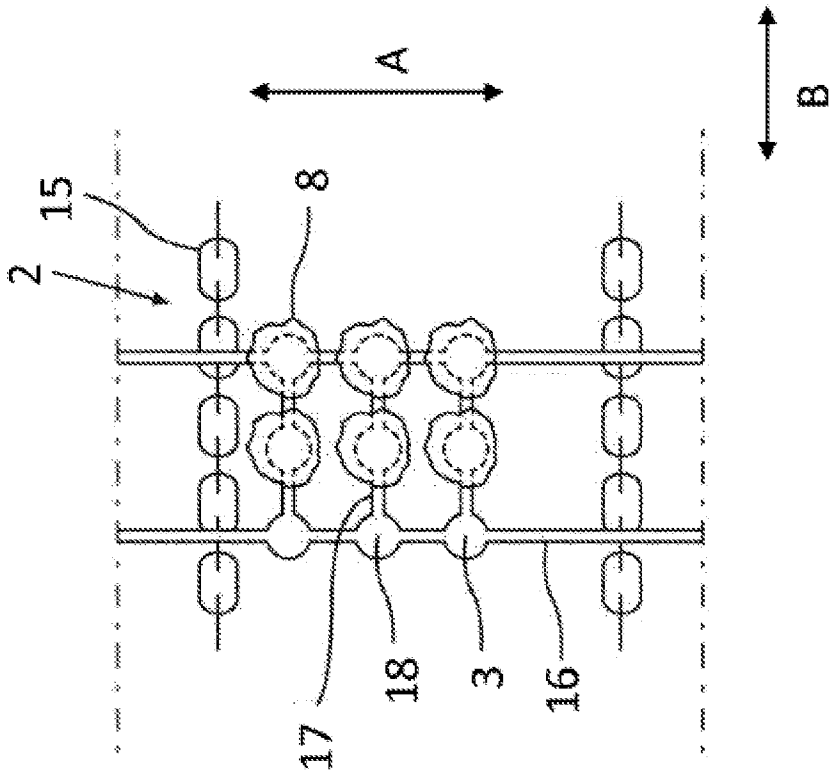

Fig. 2a