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(54) Title: DECORING MECHANISM WITH MECHANIZED HARVESTER

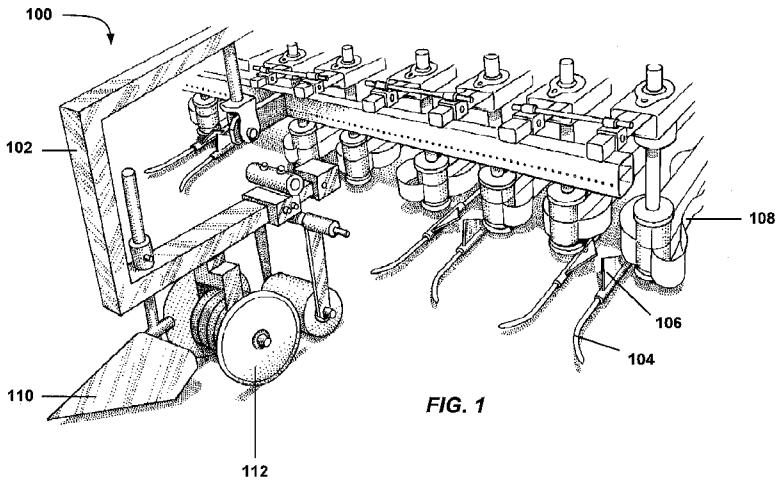


FIG. 1

(57) Abstract: A mechanical harvester for harvesting produce with a core planted in a field is provided. The mechanical harvester includes a chassis, a positioning apparatus, a decoring device, and a transport assembly. The positioning apparatus is connected to the chassis and configured to position the produce in the ground for harvesting and decoring. The decoring device is connected to the positioning apparatus and configured to sever the core of the produce while the produce is in the ground. The transport assembly is connected to the chassis and configured to lift the cut produce from the ground and transport the cut produce to a processing unit or a storage container.

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DECORING MECHANISM WITH MECHANIZED HARVESTER

BACKGROUND

1. Field

[0001] The present disclosure generally relates to mechanically harvesting and decoring agricultural products, and, more particularly, to a mechanical harvester for harvesting and mechanically removing the core from produce planted in a field, the produce having a core, such as iceberg lettuce, romaine lettuce, and cabbage.

2. Description of Related Art

[0002] Romaine lettuce, iceberg lettuce, and cabbage are commercially planted as seeds or seedlings in rows in a field. Because these types of produce tend to be somewhat irregular and delicate, commercial harvesting of these produce is generally a manual process.

[0003] Conventionally, the harvesting process involves several steps. First, a field worker harvests the produce using a harvesting knife, by cutting the stem of the produce planted in the ground. Next, the field worker removes the core and any remnant amount of stem. The field worker then places the harvested produce on a moving platform for subsequent processing and packing. This decoring step is performed by field workers, who are preparing the harvested produce for commercial packaging (*e.g.*, for prepackaged salad mixes).

[0004] This labor-intensive decoring step often requires a worker with an experienced eye to remove the core so as to maximize the desirable portions and minimize the waste portions of the harvested produce. A poorly cut produce will result in too much waste material remaining attached to the produce, or too many desirable portions ending up in waste.

BRIEF SUMMARY

[0005] In one exemplary embodiment, a mechanical harvester for harvesting and decoring a produce planted in a field is provided. The mechanical harvester includes a chassis, to which is attached a positioning apparatus, a decoring device, and a transport assembly. The positioning apparatus is configured to position the produce in the ground for harvesting and decoring, and includes a first positioning arm and a second positioning arm. Each of the two positioning arms has a straight section and a bent section. The bent sections

of the positioning arms are bent away from each other to receive the produce in the ground as the mechanical harvester moves forward. The straight sections of the positioning arms are configured to hold the produce in place for decoring. The decoring device is configured to sever the core of the produce, which remains attached to the roots in the ground. The transport assembly is configured to lift the cut produce off of the severed core and transport the cut produce to a processing unit or a storage container.

DESCRIPTION OF THE FIGURES

[0006] The present application can be best understood by reference to the following description taken in conjunction with the accompanying figures, in which like parts may be referred to by like numerals:

[0007] FIG. **1** depicts an exemplary embodiment of a mechanical harvester;

[0008] FIG. **2** depicts a positioning apparatus of the exemplary mechanical harvester;

[0009] FIGS. **3A** (top view), **3B** (side view), and **3C** (front view) depict a positioning apparatus and a decoring device of the exemplary mechanical harvester;

[0010] FIGS. **4A**, **4B**, and **4C** illustrate an exemplary method of harvesting and decoring produce with a mechanical harvester; and

[0011] FIG. **5** depicts another exemplary embodiment of a mechanical harvester with roller guides.

DETAILED DESCRIPTION

[0012] To provide a more thorough understanding of the present invention, the following description sets forth numerous specific details, such as specific configurations, parameters, examples, and the like. It should be recognized, however, that such description is not intended as a limitation on the scope of the present invention but is intended to provide a better description of the exemplary embodiments.

[0013] With reference to FIG. **1**, an exemplary mechanical harvester **100** is depicted. As described below, mechanical harvester **100** is configured to harvest and decore produce having a core, such as romaine lettuce, iceberg lettuce, cabbage, or the like. To harvest and decore produce in the field, mechanical harvester **100** moves through the field while severing the produce from its core to release the produce, lifting the released produce from the ground,

and transporting the released produce. The released produced that is decored may be transported to a storage bin or a container for future processing, or to a processing platform connected to mechanical harvester **100** for more immediate processing. Processing may include, for example, inspecting, sorting, trimming, washing, and packaging.

[0014] As depicted in FIG. **1**, mechanical harvester **100** includes chassis **102**. A positioning apparatus **104** is connected to chassis **102** to position the produce in the ground for harvesting and decoring by decoring device **106**.

[0015] As depicted in FIG. **2**, in the present exemplary embodiment, positioning apparatus **104** includes positioning arms **202** and **204**. Each of positioning arms **202** and **204** has bent section **206** and straight section **208**. Bent sections **206** of positioning arms **202** and **204** receive the produce within the row. As mechanical harvester **100** moves forward, the straight sections **208** of positioning arms **202** and **204** hold the produce in place, and decoring device **106** cuts through the produce to sever the core.

[0016] As depicted in FIG. **2**, bent sections **206** of positioning arms **202** and **204** are bent away from each other. Each of positioning arms **202** and **204** form an interior angle (depicted by element **210**) of 15 degrees. It should be recognized, however, that the size of interior angle **210** may vary. Interior angle **210** may be anywhere from 0 degrees to 60 degrees. It should be recognized that bent sections **206** of positioning arms **202** and **204** are configured to receive the produce in a way that minimizes bruising or damage to the produce, which may be planted or have grown slightly to the left or right within a row. In the exemplary embodiment, as depicted in FIG. **2**, the bent sections of the positioning arms may be curved. In other exemplary embodiments, the bent sections of the positioning arms may be straight or have an irregular shape.

[0017] Once the produce is received by the bent sections of the positioning arms, straight section **208** holds the produce in place for decoring. As depicted in FIG. **2**, positioning arms **202** and **204** in straight section **208** have a parallel configuration with a width (depicted by element **212**) of 4 inches. It should be understood, however, that width **212** may vary depending on the type of produce harvested. Width **212** may be anywhere between 1 inch to 10 inches apart. In some embodiments, width **212** may be 1, 2, 3, 4, 5, 6, 7, 8, 9, or 10 inches apart. Width **212** is selected to firmly hold the produce in place for decoring, while avoiding

bruising or damage to the produce. Moreover, in other embodiments, the width near the end that receives the produce may differ from the width near the end connected to the chassis.

[0018] It should be recognized, however, that the positioning apparatus may have any configuration that can receive and hold the produce for harvesting and decoring. Once the produce is held firmly in place by positioning apparatus **104**, the produce is ready for decoring as mechanical harvester **100** moves forward in the field. Decoring device **106** may be integrated with positioning apparatus **104**. In particular, decoring device **106** may be integrated with positioning arms **202** and **204**.

[0019] As depicted in FIGS. **3A**, **3B**, and **3C**, in the exemplary embodiment, the decoring device has blades **302** and **304** connected to positioning arms **202** and **204**, respectively. Blades **302** and **304** have a straight cutting edge with a length (depicted by element **308** in FIG. **3B**) of 3 inches. Blades **302** and **304** have a V-shaped configuration, in which the blades form an interior angle (depicted by element **306** in FIG. **3C**) of 30 degrees. As mechanical harvester **100** moves forward in the field, the decoring device fixed to the mechanical harvester moves forward and cuts through the produce held in place by the positioning apparatus. As depicted in FIGS. **3A** and **3C**, blades **302** and **304** cut the core on two sides. The cuts sever the core from the produce, and the severed core remains attached to the roots of the produce in the ground.

[0020] It should be understood, however, that length **308** (FIG. **3B**) and interior angle **306** (FIG. **3C**) of decoring device **106** may vary depending on the type of produce and the size of the core to be removed for that particular type of produce. Length **308** may be anywhere from 0.5 inches to 5 inches. In some embodiments, length **308** may be 0.5, 1, 1.5, 2, 2.5, 3, 3.5, 4, 4.5, or 5 inches. Interior angle **306** may be anywhere from 0 degrees to 120 degrees. In some embodiments, interior angle **306** may be 0, 5, 10, 15, 20, 25, 30, 35, 40, 45, 50, 55, 60, 65, 70, 75, 80, 85, 90, 95, 100, 105, 110, 115 and 120 degrees.

[0021] While FIGS. **3A**, **3B**, and **3C** depict the decoring device with two straight blades connected to positioning apparatus **104**, the decoring device may include any cutting device connected to mechanical harvester **100**, and configured to slice the core on two sides. In another exemplary embodiment, decoring device **106** includes one V-shaped blade connected to chassis **102**. Other examples of suitable cutting devices may include one or more flat

blades, curved blades, knives (*e.g.*, ultrasonic, vibrating knife), bandsaws, rotating blades or water jet-cutting devices.

[0022] Although two positioning apparatus and decoring devices have been depicted in FIGS. **1** and **2**, it should be recognized that any number of positioning apparatus and decoring devices may be used to harvest and decore produce from multiple rows of produce at a time. Multiple positioning apparatuses **104** and decoring devices **106** may be included in mechanical harvester **100** to cut produce from multiple rows of produce at one time. In other words, mechanical harvester **100** can harvest from at least as many rows of produce as the number of positioning apparatus **104** and decoring devices **106** that are included in mechanical harvester **100**.

[0023] After severing the core from the rest of the produce, a transport assembly connected to the mechanical harvester lifts the cut produce off of the severed core. It should be understood that any transport assembly capable of moving the cut produce to a bin, container, or platform for further processing may be employed. As depicted in FIG. **1**, in the exemplary embodiment, transport assembly **108** is made up of movable belts configured to hold, lift, and transport the produce after the produce is cut from its core. The movable belts may deposit the produce onto a moving platform or an elevator belt to be transported to a platform for further processing. Processing steps may include, for example, inspecting, sorting, trimming, washing, and packaging. Alternatively, the moveable belts may deposit the produce into a storage bin or a container.

[0024] Furthermore, as depicted in FIG. **1,** mechanical harvester **100** includes plow **110** positioned in front of decoring device **106**. In a position forward to the decoring device, the plow may reach the produce before the decoring device when mechanical harvester **100** is moving. In other exemplary embodiments, a plow may be optionally connected to the mechanical harvester. The plow may keep vegetation and other debris from collecting on the decoring device. Additionally, mechanical harvester **100** may include more than one plow in a position forward to wheel **112** of mechanical harvester **100**. The plow may also keep vegetation and other debris from collecting on wheel **112** of mechanical harvester **100**.

[0025] The mechanical harvester may include additional devices to align and position the produce in the ground for harvesting by decoring device **106**. As depicted in FIG. **5**, in another exemplary embodiment, mechanical harvester **500** includes chassis **502**. A

positioning apparatus **504** is connected to chassis **502** to position the produce in the ground for harvesting and decoring by decoring device **506**. Additionally, mechanical harvester **500** has roller guide **510**, which is connected to chassis **502**. Roller guide **510** includes a series of rollers that help position produce lying at an angle in the ground for decoring. By adjusting the angle of the produce in the ground, the produce may be better aligned for harvesting and decoring by decoring device **506**. While FIG. **5** depicts roller guide **510**, it should be understood that any devices or methods known in the art that can be used to guide produce lying at an angle into the decoring device may be employed.

[0026] The harvesting and decoring process performed in the field is illustrated in FIGS. **4A**, **4B**, and **4C**. With reference to FIG. **4A**, the direction of travel of mechanical harvester **100** (FIG. **1**) brings the positioning apparatus **104** (FIG. **1**) to produce **300** (FIG. **3**). With reference to FIG. **4B**, as mechanical harvester **100** (FIG. **1**) moves forward, positioning apparatus **104** (FIG. **1**) positions and holds produce **300** (FIG. **3**) in place as coring device **106** (FIG. **1**) exerts sufficient force to cut through produce **300** (FIG. **3**). The belts of the transport system engage with the produce while the coring knives penetrate the produce. This helps facilitate the cutting and coring of the produce, otherwise, if the produce has a weak root system, the coring knives may push the produce rather than cut through it. With reference to FIG. **4C**, as mechanical harvester **100** (FIG. **1**) continues to travel through the field, transport assembly **108** (FIG. **1**) lifts and moves cut produce **402** towards the rear of mechanical harvester **100** (FIG. **1**).

[0027] The foregoing descriptions of specific embodiments have been presented for purposes of illustration and description. They are not intended to be exhaustive, and it should be understood that many modifications and variations are possible in light of the above teaching.

CLAIMS

What is claimed is:

1. A mechanical harvester for harvesting and decoring a produce planted in a field, the produce having a core, a stem, and roots extending from the stem when the produce is growing in the ground, the mechanical harvester comprising:

a chassis;

a positioning apparatus configured to position the produce in the ground for harvesting and decoring, wherein the positioning apparatus comprises:

a first positioning arm; and

a second positioning arm,

wherein each of the first and second positioning arms has a straight section and a bent section, and wherein the bent sections of the first and second positioning arms are bent away from each other;

a decoring device configured to sever the core of the produce while the produce is in the ground; and

a transport assembly comprising one or more moveable belts, configured to lift the cut produce from the ground, and transport the cut produce to a processing unit or a storage container,

wherein the positioning apparatus, the decoring device, and the transport assembly are connected to the chassis.

2. The mechanical harvester of claim 1, wherein the first and second positioning arms in the bent section are bent away from each other, and wherein each positioning arm is bent to form an interior angle of 0 degrees to 60 degrees.

3. The mechanical harvester of claim 1, wherein the first and second positioning arms in the straight section have a width of 1 inch to 10 inches.

4. The mechanical harvester of claim 1, wherein the decoring device comprises a V-shaped cutting device connected to the positioning apparatus.

5. The mechanical harvester of claim 1, wherein the decoring device comprises a first blade connected to the first positioning arm and a second blade connected to the second positioning arm, and wherein the first blade and the second blade are configured in a V-shape to sever the core of the produce.

6. The mechanical harvester of claim 5, wherein the V-shaped configuration of the first and second blades has an interior angle of 0 degrees to 120 degrees.

7. The mechanical harvester of claim 5, wherein the first and second blades each have a length of 0.5 inches to 5 inches.

8. The mechanical harvester of claim 1, further comprising:

one or more roller guides, wherein the one or more roller guides are connected to the chassis, and wherein the one or more roller guides position the produce in the ground for harvesting and decoring.

9. The mechanical harvester of claim 1, wherein the transport assembly is further configured to pull the produce through the decoring device.

10. The mechanical harvester of claim 1, wherein the transport assembly comprises:

a movable first belt, wherein the movable first belt includes a first set of produce grippers; and

a movable second belt, wherein the movable second belt includes a second set of produce grippers,

wherein a portion of the first set of produce grippers opposes a portion of the second set of produce grippers, when the cut produce is held between the first set and second set of produce grippers, and

wherein the opposing produce grippers are configured to compress and exert a force on the cut produce to hold the cut produce between the movable first and second belts.

11. A mechanical method of harvesting a produce planted in a field using a mechanical harvester, the produce having a core, a stem, and roots extending from the stem when the produce is growing in the ground, the method comprising:

positioning the produce in the ground for harvesting and decoring;

severing the core of the produce with a decoring device connected to a chassis of the mechanical harvester, wherein the severed core remains attached to the roots in the ground;

lifting the cut produce from the ground; and

transporting the cut produce with a transport assembly to a processing unit or a storage container.

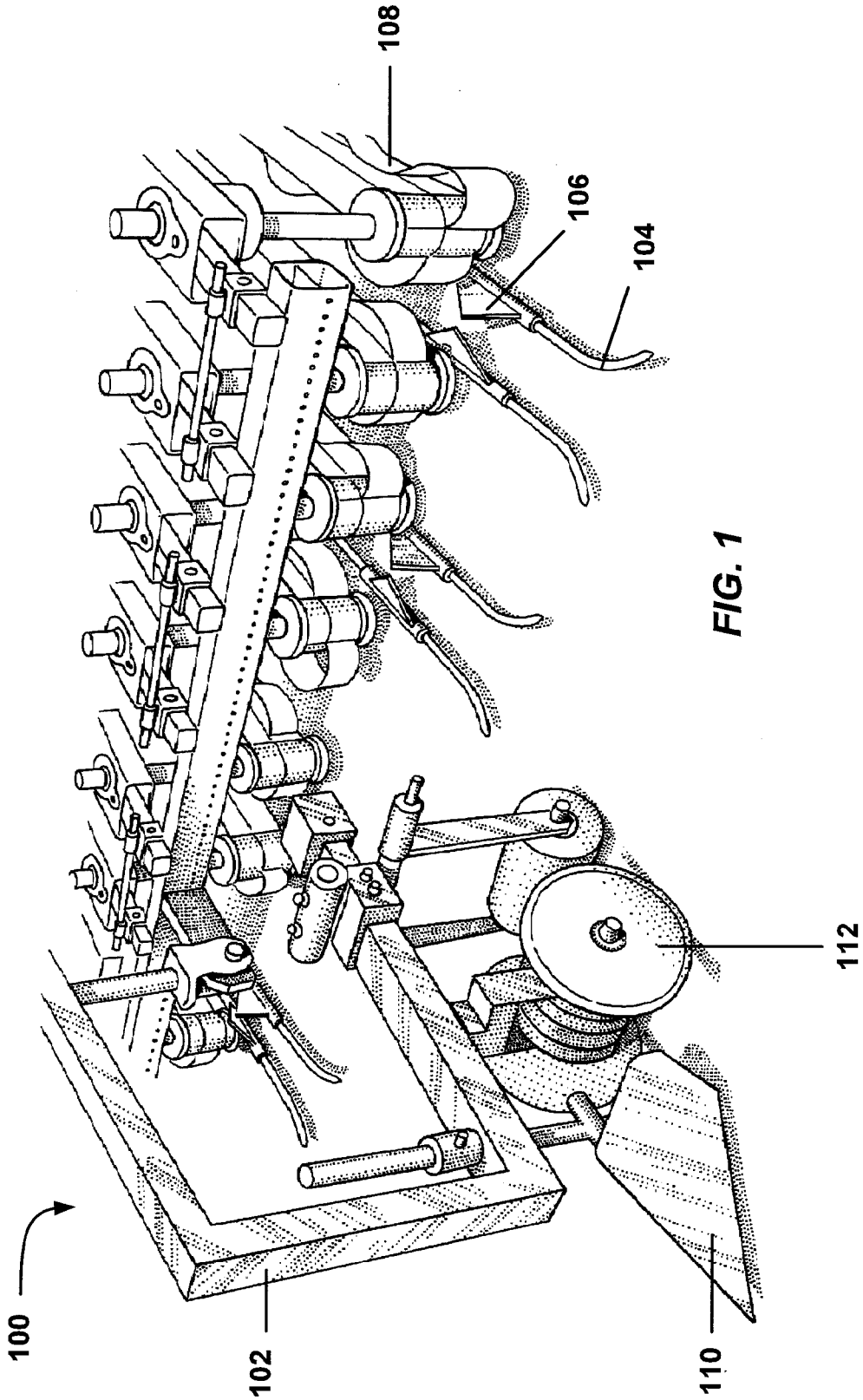


FIG. 1

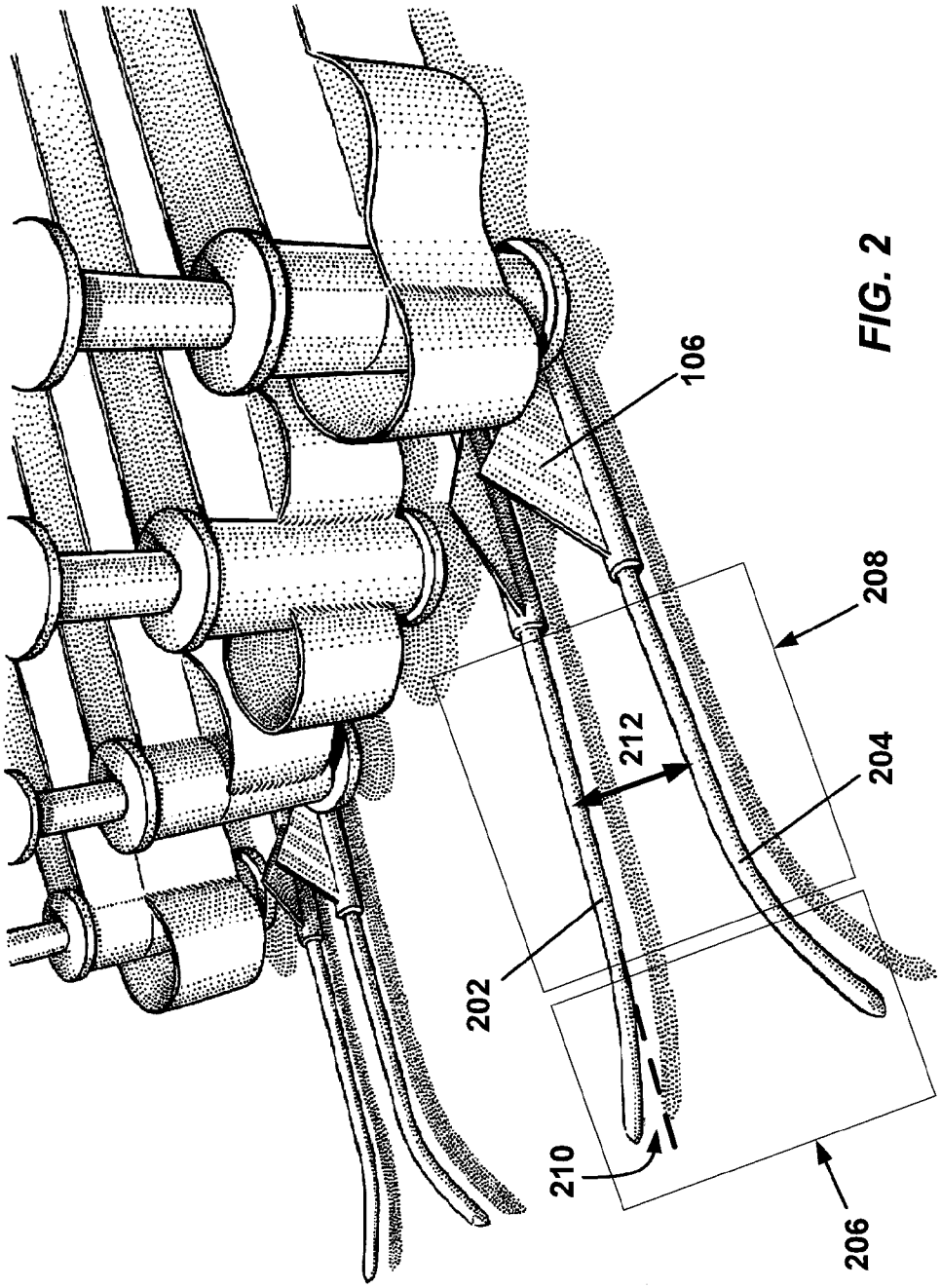


FIG. 2

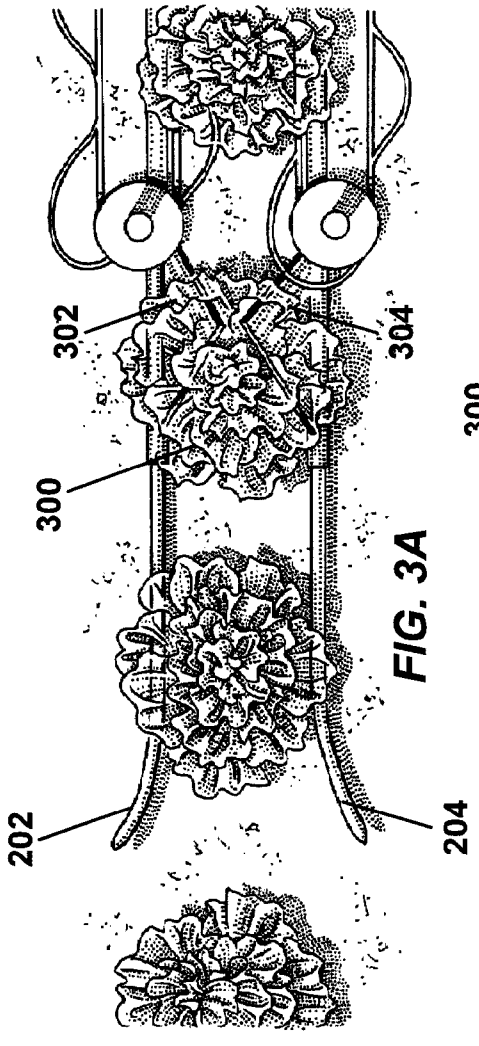


FIG. 3A

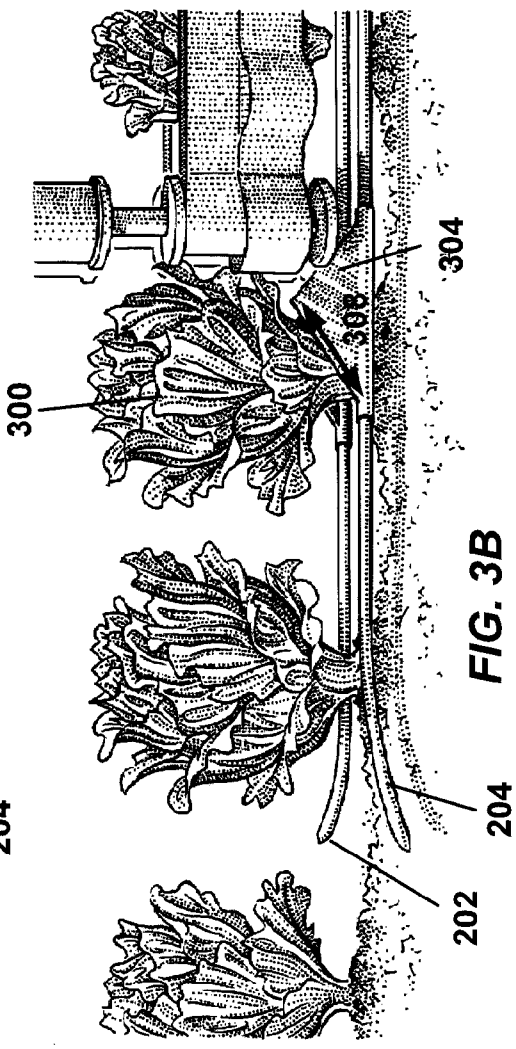


FIG. 3B

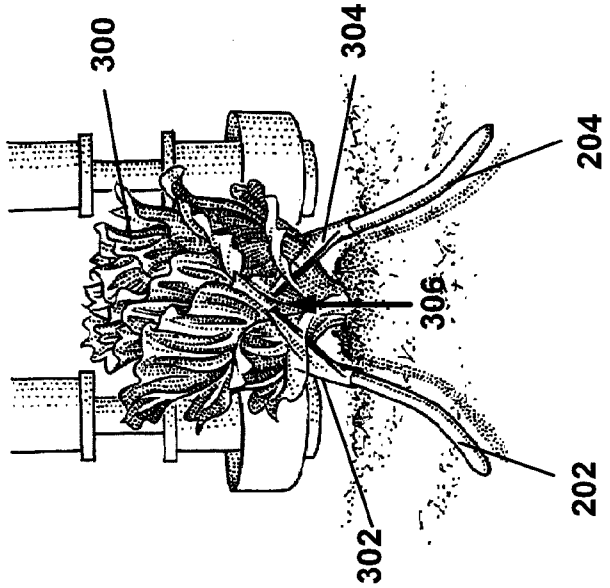


FIG. 3C

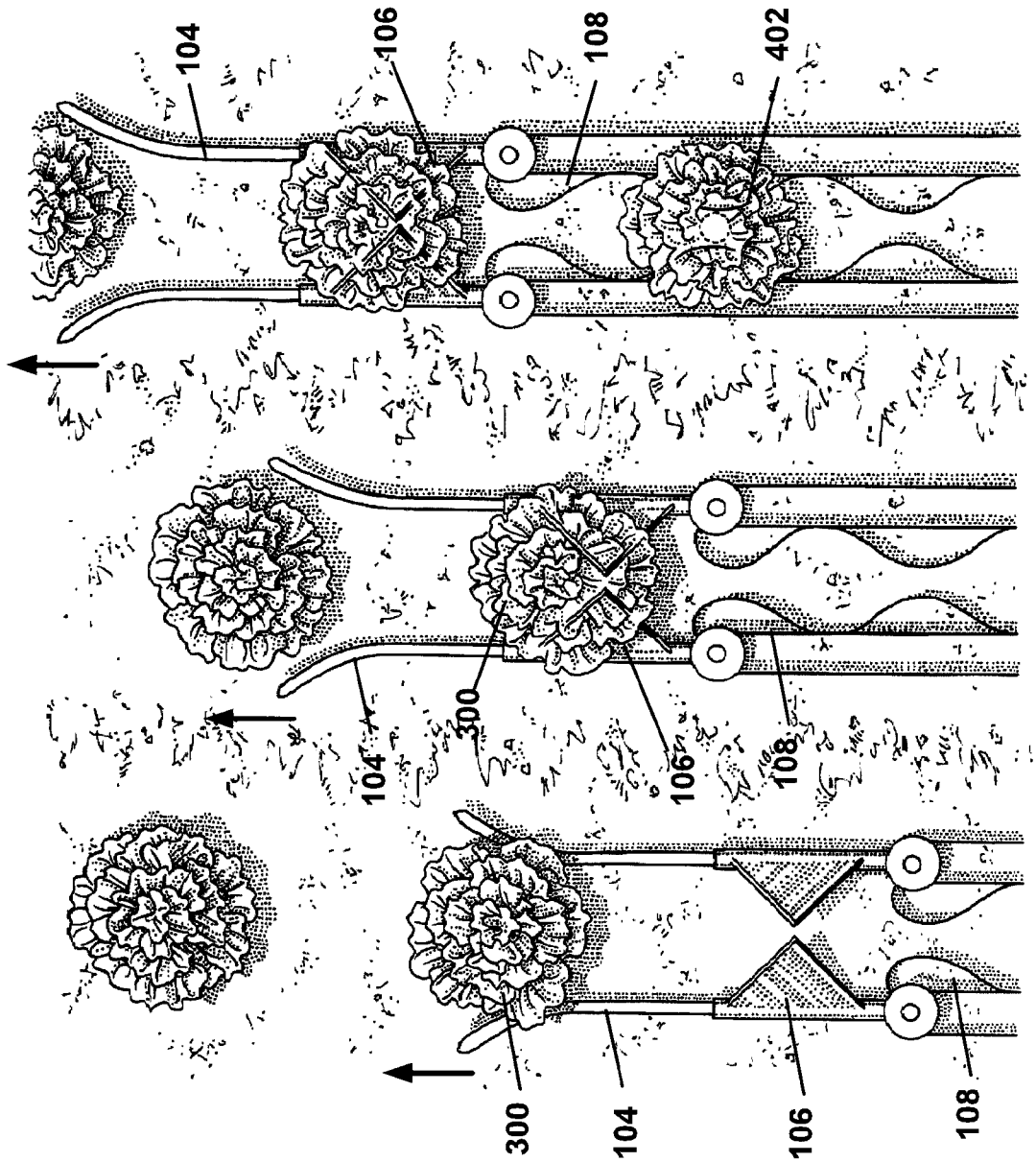


FIG. 4C

FIG. 4B

FIG. 4A

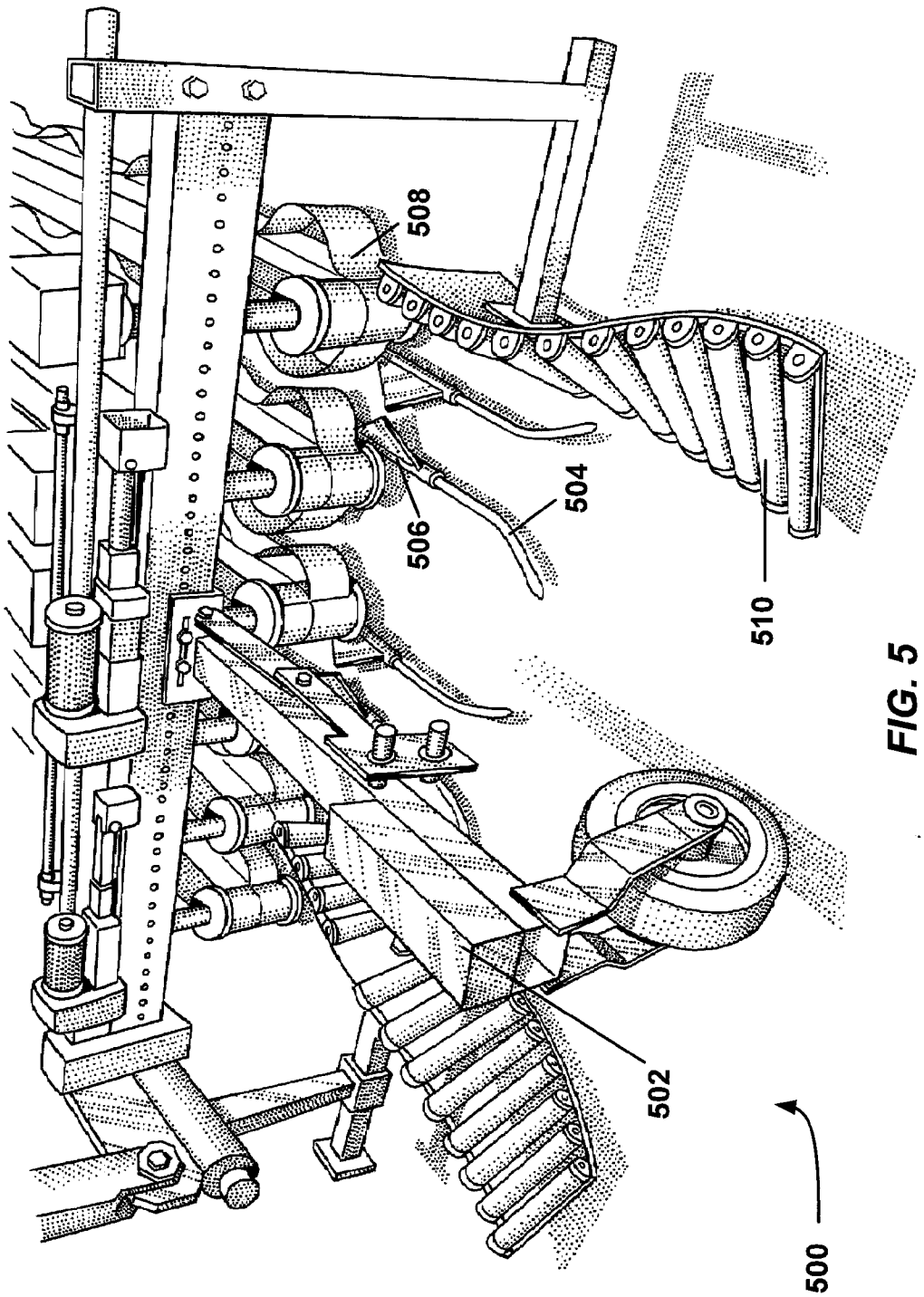


FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2011/057917

A. CLASSIFICATION OF SUBJECT MATTER
IPC(8) - A01D 45/26 (2012.01)
USPC - 56/327.1
According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC(8) - A01D 45/00, 45/26 (2012.01)
USPC - 56/13.6, 288, 289, 327.1, 328.1, DIG2; 99/512, 538, 542, 544, 547; 171/10, 21, 53, 62

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X -- Y	US 3,586,108 A (WEDGEWORTH) 22 June 1971 (22.06.1971) entire document	1-3, 8-11 ---------- 1, 4-7
Y	US 3,485,023 A (SEE) 23 December 1969 (23.12.1969) entire document	1, 4-7

☐ Further documents are listed in the continuation of Box C. ☐

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

Date of the actual completion of the international search	Date of mailing of the international search report
18 February 2012	08 MAR 2012
Name and mailing address of the ISA/US Mail Stop PCT, Attn: ISA/US, Commissioner for Patents P.O. Box 1450, Alexandria, Virginia 22313-1450 Facsimile No. 571-273-3201	Authorized officer: Blaine R. Copenheaver PCT Helpdesk: 571-272-4300 PCT OSP: 571-272-7774