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(54) **Automatizált kutatási ültetési rendszer és eljárás**

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(54) AUTOMATED RESEARCH PLANTING SYSTEM AND METHOD

AUTOMATISIERTES FORSCHUNGSPFLANZUNGSSYSTEM UND -VERFAHREN

SYSTÈME ET PROCÉDÉ DE PLANTATION DE RECHERCHE AUTOMATISÉE

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(56) References cited:
WO-A2-2008/006063
US-A1- 2001 000 806
US-A1- 2008 006 627
US-A1- 2009 010 750
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Description

FIELD OF THE INVENTION

[0001] The various embodiments of the present invention relate generally to an automated system, method, and apparatus for preparing an agricultural research plot. More specifically, embodiments of the present invention provide an automated system, method, and apparatus for dispensing seed samples into an agricultural research plot and for managing information relating to the dispensing of the seed samples.

BACKGROUND OF THE INVENTION

[0002] It is typical for a company in the agricultural seed industry to generate one or more research plots in order to evaluate certain seed varieties. Such seed varieties may include, but need not be limited to, seeds from a specific source, genotype, population, and/or breeding line. In such a manner, researchers may evaluate characteristics of the plants growing in the research plot, as well as characteristics of any crops produced from the plants. In some instances these characteristics may be compared to plants grown from different seed varieties in the research plot. Thus, certain experiments may require a researcher to plant many different seed varieties in the research plot at approximately the same time. Additionally, a researcher may desire to plant various seed varieties in relatively close proximity to other seed varieties.

[0003] Traditional research plot planting is a largely manual process. Conventional techniques require seed samples to be packaged in small paper coin envelopes, which are manually opened at the desired planting locations in order to deposit the seed samples for planting research plots. In many instances this is accomplished by using a mobile planter transport device that transports a research seed planter configured to carry a seed planting operator. **FIG. 1** shows a typical prior art research seed planter **10,** configured to carry a seed planting operator to plant two rows of seed in a research plot. A similar research planter is available, for example, from ALMACO of Nevada, Iowa. The research seed planter **10** of **FIG. 1** is configured to be pulled behind a mobile planter transport device, in this case a tractor operated by a tractor operator. As shown in the figure, the typical prior art research seed planter **10** includes a planting operator seat **12,** a seed storage area **14,** and one or more seed metering systems **18.** In such a manner, a seed planting operator may ride along with the research seed planter **10** as the research seed planter **10** is pulled through the research plot. Seeds that are to be planted in the research plot are contained in coin envelopes that are stored in the seed storage area **14.** As the research seed planting device is transported through the research plot, the seed planting operator accesses the coin envelopes and opens the envelopes into seed funnels **16** that deliver the seed to seed metering systems **18** for depositing the seeds into the research plot. In order to track the location of various seed varieties, a map may be manually created that describes the locations of the various seed varieties based on the planned distribution of seeds. In other applications, a map based on randomization of an experiment plan may be electronically generated based on the planned distribution of seeds. In either event, the map is generated before seeds are planted in the research plot and thus the map represents where the seeds are supposed to be planted in the research plot and not necessarily where the seeds are planted. This process is susceptible to various forms of error. For example, it requires that the seed planting operator identify the proper seed envelope and deposit the contents of the envelope into the proper seed funnel at the proper time and location. Although the research seed planter **10** shown in the figure carries a single operator for planting two rows of seed in a research plot, many research seed planters carry additional seed planting operators and are configured to plant several additional rows. With each additional operator, however, errors of the type discussed above are multiplied. For example, another common research seed planter carries four seed planting operators and is configured to plant eight rows of seed in a research plot, with each operator being responsible for planting two rows. However, each of the four operators may be capable of making the errors discussed above. Additionally, because the manual nature of these prior art processes, various errors are also introduced into the map of seed locations.

[0004] US 2001/0000806A1 discloses a GPS system to provide planter tripping for crop research plots. The GPS system provides the longitude and latitude of the first trip location and provide a continuous flow of location information. A control computer calculates the next tripping location and provides a signal to the planter at that location and each subsequent tripping location in the field grid. A GPS receiver mounted on the planter provides location information. The computer selectively causes the planter to plant seed and to stop planting seed as the planter progresses longitudinally through the filed as the GPS data advises the computer that the planter has travelled a predetermined distance. The GPS device provides data to the computer both as to the distance and the direction travelled by the planter, so that seeds will be planted in the rows of the plots without planting seeds in the alleys between those plots. Therefore, the device can continually plant seeds in longitudinal rows in a field without stopping and without wasting seeds in the alleys.

[0005] In a research setting, the ability to accurately, consistently, and predictably populate a research plot is very important. However, as noted above, conventional research planting procedures rely heavily on manual processes. Reliance on manual processes prevents conventional methods from quickly and accurately adapting to changes in research plans, which may describe a desired seed planting distribution within one or more re-

search plots. Because conventional planting methods rely on records developed prior to planting the research plot to maintain the identification and traceability of planted seed samples, such reliance could introduce error that may be detrimental to the integrity of the results of experiments that rely on accurate research seed plot maps.

[0006] As a result, there is a need in the art for an automated research seed planting system and associated method. In various embodiments, the automated research seed planting system and method should significantly reduce the manual processes involved in planting a research plot. Additionally, the automated research seed planting system and method should improve the accuracy of the planting system such that characteristics of the research plot, such as the identity, location, and time that seeds were deposited into the research plot, are readily and accurately determined.

SUMMARY OF THE INVENTION

[0007] The present invention addresses the above needs and achieves other advantages by providing an automated research seed planting system, method, and apparatus. In general, the automated research seed planting system comprises a planter configured for planting a research plot and comprising a seed package assembly handling device comprising a seed tray assembly configured to hold a plurality of seed package assemblies, each seed package assembly containing a research seed sample, and a controller configured to communicate with the seed package assembly handling device. The controller is configured to control the seed package assembly handling device to automatically release the research seed sample from the seed package assembly. In some embodiments, the controller may be further configured to automatically control the seed package handling device to apply a force to the seed package assembly to release the research seed sample from the seed package assembly.

[0008] In some embodiments, the seed package assembly handling device may be configured to open a seed package assembly comprising first and second portions that cooperate to contain the research seed sample, and the seed package assembly handling device may be configured to apply a force to the seed package assembly so that the first and second portions of the seed package assembly at least partially separate thus releasing the research seed sample. In some embodiments, the controller may be configured to control the seed package assembly handling device to bypass releasing the research seed sample from the seed package assembly. In some embodiments, the controller may be configured to control the seed package assembly handling device according to one or more instruction sets. In some embodiments, one or more instructions sets may be derived from one or more research plans. In some embodiments, at least one of the research plans or the instruction sets may be stored in at least one data store. In some embodiments, the force may comprise at least a compressive force and the compressive force may cause at least one of the first or second portions of the seed package assembly to flex outwardly from the other portion about a flexure axis so that the first and second portions at least partially separate in response to the force, thus releasing the research seed sample.

[0009] In some embodiments, the seed package assembly handling device may further comprise an opening tool and a disengaging tool, and the controller may further be configured to cause the opening tool to contact between the first and second portions of the seed package assembly and to automatically control the seed package assembly handling device to apply a second force to the package assembly via the disengaging tool, for encouraging at least one of the first or second portions to flex outwardly from the other portion about the flexure axis so that the first and second portions separate. In some embodiments, the seed package assembly may include at least one of a machine-readable or human-readable label. Some embodiments may further comprise a seed package assembly sensor device configured for reading the label of the seed package assembly. In some embodiments, the seed package assembly sensor device may comprise a device selected from the group consisting of a bar code reader, an OCR reader, an RFID reader, and combinations thereof. In some embodiments, the planter may further comprise a seed metering device configured to receive the research seed sample from the seed package assembly handling device, and the seed metering device may be configured to separate individual seeds from the research seed sample and to release the individual seeds into the research plot. Some embodiments may further comprise a seed meter sensor device configured to sense individual seeds as the individual seeds are released into the research plot.

[0010] Some embodiments may further comprise a positional data acquisition device configured to acquire position data relating to a position of the released research seed sample. Some embodiments may further comprise a positional data acquisition device configured to acquire position data and wherein the controller may be configured to control the seed package assembly handling device according to the position data and one or more instruction sets. In some embodiments, the planter may comprise a plurality of seed package assembly handling devices each configured to receive a respective seed package assembly of a plurality of seed package assemblies, and one or more controllers may be configured to automatically control each seed package assembly handling device to release a respective research seed sample into the research plot. In some embodiments, the planter may further comprise a plurality of seed metering devices each configured to receive a respective research seed sample from a respective seed package assembly handling device, and each seed metering device may be further configured to separate individual seeds from the respective research seed sample and to release the in-

dividual seeds into the research plot. Some embodiments may further comprise a plurality of seed meter sensor devices configured to sense individual seeds as the individual seeds are released into the research plot. In some embodiments, the planter may be configured to plant four rows and may comprise four seed package assembly handling devices and four respective seed metering devices, and wherein each seed package assembly handling device may be configured to release at least a portion of a respective seed sample into a respective seed metering device. In some embodiments, the planter may be configured to plant eight rows and may comprise four seed package assembly handling devices, four seed sample splitting devices, and eight seed metering devices, and wherein each seed package assembly handling device may be configured to release at least a portion of a respective seed sample into a respective pair of the eight seed metering devices via a respective seed sample splitting device.

[0011] Another embodiment of the present invention provides a method of planting a research plot. In general, the method comprises transporting a planter that comprises a seed package assembly handling device comprising a seed tray assembly that holds a plurality of seed package assemblies, each seed package assembly containing a research seed sample, moving the seed tray assembly to align the seed package assembly with a loading area and controlling the seed package assembly handling device using a controller to automatically release the research seed sample. Some embodiments may further comprise automatically controlling the seed package handling device to apply a force to the seed package assembly to release the research seed sample from the seed package assembly.

[0012] In some embodiments, the seed package assembly handling device may receive a seed package assembly comprising first and second portions that cooperate to contain the research seed sample and applying a force to the seed package assembly may cause the first and second portions of the seed package assembly to at least partially separate thus releasing the research seed sample. Some embodiments may further comprise controlling the seed package assembly handling device to bypass releasing the research seed sample from the seed package assembly. In some embodiments, the controller may be configured to control the seed package assembly handling device according to one or more instruction sets. In some embodiments, one or more instructions sets may be derived from one or more research plans. In some embodiments, at least one of the research plans or the instruction sets may be stored in at least one data store. In one embodiment, controlling the seed package assembly handling device may comprise controlling the seed package assembly handling device to automatically apply at least a compressive force to the seed package assembly and wherein the compressive force may cause at least one of the first or second portions of the seed package assembly to flex outwardly from the other portion about a flexure axis so that the first and second portions at least partially separate in response to the force, thus releasing the research seed sample.

[0013] Some embodiments may further comprise controlling the seed package assembly handling device using the controller to cause an opening tool to contact between the first and second portions of the seed package assembly and to apply a second force to the package assembly via a disengaging tool for encouraging at least one of the first or second portions to flex outwardly from the other portion about the flexure axis so that the first and second portions separate. Some embodiments may further comprise reading a label on the seed package assembly using a seed package assembly sensor device. Some embodiments may further comprise using a seed metering device to receive the research seed sample from the seed package assembly handling device, separate individual seeds from the research seed sample, and release the individual seeds into the research plot. Some embodiments may further comprise sensing individual seeds using a seed meter sensor device as the individual seeds are released into the research plot. Some embodiments may further comprise using a positional data acquisition device to acquire position data relating to a position of the released research seed sample. In some embodiments, the planter may comprise a plurality of seed package assembly handling devices each configured to open a respective seed package assembly of a plurality of seed package assemblies, and controlling the seed package assembly handling device may comprise controlling each of the plurality of seed package assembly devices using one or more controllers release the respective research seed sample into the research plot. Some embodiments may further comprise using a plurality of respective seed metering devices to receive the respective research seed samples from the seed package assembly handling devices, separate individual seeds from the research seed samples, and release the individual seeds into the research plot.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] Having thus described the invention in general terms, reference will now be made to the accompanying drawings, which are not necessarily drawn to scale, and wherein:

FIG. 1 shows a typical prior art operator-controlled research seed planter, configured to plant two rows of seeds in a research plot;

FIG. 2 shows an automated research seed planter in accordance with an exemplary embodiment of the present invention configured to plant four rows of seeds in a research plot;

FIG. 3 shows a schematic drawing of portions a research seed planter in accordance with an exemplary embodiment of the present invention;

FIG. 4 shows a perspective view of a seed package

assembly handling device of a research seed planter in accordance with an exemplary embodiment of the present invention;

FIG. 5 shows a perspective view from a reverse angle of the seed package assembly handling device of FIG. 4 in accordance with one exemplary embodiment of the present invention;

FIG. 6 shows a seed package assembly, in an open position, for use with the seed package assembly handling device of FIG. 4 in accordance with one exemplary embodiment of the present invention;

FIG. 6A shows a seed package assembly, in a closed position, for use with the package assembly handling device of FIG. 4 in accordance with one exemplary embodiment of the present invention;

FIG. 7 shows a perspective view from a reverse angle of the seed package assembly handling device of FIG. 4 wherein a seed package assembly is being lowered by an elevator assembly into a seed package assembly handling path in accordance with one exemplary embodiment of the present invention;

FIG. 8 shows a perspective view from a reverse angle of the seed package assembly handling device of **FIG. 4** wherein a seed package assembly is being pushed by a pusher assembly along a seed package assembly handling path in accordance with one exemplary embodiment of the present invention;

FIG. 9 shows a perspective view from a reverse angle of the seed package assembly handling device of **FIG. 4** wherein a seed package assembly is being pushed by a pusher assembly along a seed package assembly handling path into an opening tool and wherein a disengaging tool is being actuated, in accordance with one exemplary embodiment of the present invention;

FIG. 10 shows a perspective view from a reverse angle of an opening tool of a seed package assembly handling device in accordance with one exemplary embodiment of the present invention;

FIG. 11 shows a side view of a seed package assembly according to one embodiment of the present invention including an exemplary flexing action of a cover portion of the seed package assembly in response to an applied compressive force;

FIG. 12 shows a side view of a seed package assembly according to one embodiment of the present invention including disengagement of a cover portion from a container portion after the application of a compressive force;

FIG. 13 shows a front perspective view of an automated research seed planting system including a mobile planter transport device and a planter in accordance with an exemplary embodiment of the present invention;

FIG. 14 shows a rear prospective view of the automated research seed planting system of **FIG. 13** in accordance with an exemplary embodiment of the present invention;

FIG. 15 shows a perspective view of a research seed planter in accordance with an exemplary embodiment of the present invention configured to plant eight rows of seeds in a research plot; and

FIG. 16 shows a schematic drawing of portions a research seed planter which includes a seed handling splitter in accordance with an exemplary embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0015] The present invention now will be described more fully hereinafter with reference to the accompanying drawings, in which some, but not all embodiments of the invention are shown. Indeed, this invention may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein; rather, these embodiments are provided so that this disclosure will satisfy applicable legal requirements. Like numbers refer to like elements throughout.

[0016] As noted above, **FIG. 1** shows a prior art operator-controlled research seed planter **10,** configured to plant two rows of seed in a research plot including a planting operator seat **12,** a seed storage area **14,** and one or more seed metering systems **18.** In a typical prior art planting process, a seed planting operator rides along with the research seed planter **10** as the planter is transported through a research plot, accesses coin envelopes, and opens the envelopes into one or more seed funnels **16** that deliver the seed to one or more seed metering systems **18** for depositing the seed into the research plot. Thus, the prior art represents a highly manual process fraught with the potential for error. The present invention presents an improvement over the prior art by providing an automated research planting system and method. In various embodiments, the automated research seed planting system and method reduce the manual processes involved in planting a research plot, and improve the accuracy of the planting system. In such a manner, characteristics of a research plot can be readily and accurately determined.

[0017] **FIG. 2** shows a research seed planter **102** in accordance with an exemplary embodiment of the present invention. In the depicted embodiment, the research seed planter **102** is configured to be transported via a mobile planter transport device and is configured to plant four rows of seed in a research plot for each pass of the research seed planter **102.** It should be noted that in other embodiments, a research seed planter in accordance with the present invention may be configured to plant any number of rows of seed as is commonly known in the art, examples may include, but need not be limited to, a research seed planter configured to plant sixteen rows or more of seed, or a research planter configured to plant one row of seed. Additionally, although in the depicted embodiment the research seed planter **102** is configured to be transported via a mobile planter transport device (such as, for example, a farm tractor, an all

terrain vehicle, one or more horses, a multipurpose vehicle such as a Unimog or Humvee, etc.), in other embodiments the research seed planter may be self-propelled, such as, for example, by including an integrated transporting mechanism or device.

[0018] As noted above, the research seed planter **102** in the depicted embodiment is configured to plant as many as four rows of seed into a research plot for each pass of the research seed planter **102** and includes four seed package handling devices **104,** each one being dedicated for each of the four rows to be planted. However, it should be noted that in other embodiments, a single seed package handling device may provide the seed for two or more rows of seed to be planted into the research plot. As will be discussed in more detail below, each seed package handling device **104** includes a seed tray assembly **105** configured to carry one or more seed package assemblies **200,** with each seed package assembly **200** being configured to contain a research seed sample comprising one or more seeds. It should also be noted that each seed package assembly handling device **104** is configured to accommodate various sizes of seed tray assemblies, however, for illustration purposes in the depicted embodiment, the closest seed tray assembly **105** comprises a larger capacity seed tray assembly **105** than the other seed tray assemblies **105** shown in the figure.

[0019] In the depicted embodiment, each seed package handling device **104** automatically opens associated seed package assemblies **200** and releases research seed samples into a respective seed handling chute **106,** which directs the seed into a respective seed metering device **108.** Associated with each row to be planted of the research seed planter **102** is a conventional furrow opening apparatus **107** and a conventional furrow closing apparatus **109.** Although various configurations of furrow opening and closing apparatuses are possible, in the depicted embodiment, the furrow opening apparatus **107** may include a pair of laterally spaced furrow opening discs and a pair of gauge wheels configured to set the depth of the furrow. The furrow closing apparatus **109** may comprise a pair of furrow closing discs. In general, as the research seed planter moves through the research plot, the furrow opening apparatus **107** opens a furrow, and individual seeds are released by the seed metering device through a drop tube **110** (not visible in FIG. 2) and into the research plot. The furrow closing apparatus **109** then closes the furrow. Seed package assemblies that have been opened are automatically deposited into respective waste containers **111,** which are associated with each seed package handling device **104.** It should be noted that in other embodiments, such as embodiments in which the seed package assemblies are constructed of biodegradable materials, there may be no need for waste containers as opened seed package assemblies may be discarded onto the ground. In still other embodiments, there may be one waste container that collects all of the opened seed package assemblies.

[0020] **FIG. 3** shows a simplified schematic drawing of a portion of the research seed planter **102** in accordance with an exemplary embodiment of the present invention. In particular, **FIG. 3** shows some of the components associated with each row to be planted including a seed package handling device **104,** a seed handling chute **106,** a seed metering device **108,** a seed drop tube **110,** a seed package assembly sensor **112,** and a seed meter sensor **113.** In general, under the control of a controller **103** each seed package handling device **104** of the depicted embodiment is configured to automatically release research seed samples into a respective seed handling chute **106,** which directs the released seed to a respective seed metering device **108.** It should be noted that for purposes of the current specification and appended drawings and claims, the term automatic, automatically, and other forms thereof refer to operations that require little, if any, manual intervention. The seed metering device **108** receives the seed released by the seed package handling device **104** and singulates the seed. Individual seeds are then released by the seed metering device through a respective drop tube **110** and into the research plot. In the depicted embodiment, the seed metering devices **108** are cone-type mechanical seed metering devices as are known in the art and available from various commercial sources, including, for example, ALMACO of Nevada, Iowa. It should be noted that in other embodiments, the seed metering devices may comprise any device configured to singulate seed. Other examples of seed metering devices configured for use with the present invention include, but are not limited to, vacuum-type seed metering devices as are known in the art and available from various commercial sources, including, for example, Seed Research Equipment Solutions, LLC of South Hutchinson, Kansas. As will be discussed in more detail below, various sensors may also be included to sense various events of the planting process. For example, the seed package assembly sensor **112** may be included for sensing information pertaining to the seed package assemblies **200** released into the seed metering device **108,** and the seed meter sensor **113** may be included for sensing seed drop events. In the depicted embodiment, the seed package assembly sensor **112** is an electronic reader configured to read identification information relating to the research seed sample contained in the package assembly **200.** In various embodiments, the seed package assembly sensor **112** may be any device capable of sensing information from the seed package assembly **200,** including, but not limited to, a barcode scanner capable of reading one or more barcodes associated with the seed package assembly **200,** an optical character recognition (OCR) reader capable of reading human-readable information associated with the seed package assembly **200,** a radio frequency identification (RFID) reader capable of identifying an RFID transponder associated with the seed package assembly **200,** and/or any combination of the above. In the depicted embodiment, the seed meter sensor **113** comprises an op-

tical seed drop sensor configured to sense the passage of a seed through the seed drop tube **110.** However, in other embodiments, the seed meter sensor **113** may comprise different sensors configured to sense seed drop events, including, for example, a sensor that senses a position of one or more components of the seed metering device **108.** For example, in some embodiments, the seed meter sensor device may sense one or more positions of the cone of a cone-type mechanical seed metering device such that the seed drop events may be determined.

[0021] In various embodiments, the research seed planter **102** (and/or an automated research seed planting system using a research seed planter) may include a positional data acquisition system **115** configured to acquire position data associated with one or more research seed planting events and/or to trigger one or more research seed planting events. In some embodiments, the positional data acquisition system **115** may communicate with the controller such that position data associated with one or more research seed planting events may be acquired and stored and/or transmitted. In various embodiments, a research seed planting event may include, for example, the release of research seed samples to the seed metering device and/or the release of individual seeds into the research plot. As such, in some embodiments, information about the location(s) of the research seed planting events may be analyzed and compared to existing research plans, which may indicate the targeted location(s) for the research seed planting events. In other embodiments, research plot maps may be generated using location(s) of the research seed planting events. In still other embodiments, research plots may be planted, such as according to one or more research plans, by triggering seed planting events at predetermined locations based on one or more research plans.

[0022] In various embodiments, a positional data acquisition system **115** may include, for example, one or more of the following: a timer system, a timer and encoder system, a cable system, a dead reckoning system, a satellite navigation system, etc. An example of a cable system may include, but need not be limited to, a cable that is wound about a spool and that includes position indicator buttons placed periodically along the length thereof. As a research seed planter is moved through the research plot, the cable is unwound and the position indicator buttons are sensed by a check-head or other sensing device. An example of a satellite navigation system may include, but need not be limited to, the global positioning system (GPS) or the International Global Navigation Satellite System (GNSS) Service (IGS). GPS systems enable very accurate location determination or position fixing by utilizing measurements of precise timing signals broadcast from a constellation of more than two dozen GPS satellites in orbit around the earth. Locations can be determined, for example, in terms of longitude, latitude, and altitude regardless of time, weather and location. Other satellite navigation systems include, but need not be limited to, International Global Navigation Satellite Systems (GNSS) Service (IGS), which have incorporated NAVSTAR satellites of the United States and GLONASS satellites from Russia along with additional satellite constellations to provide robust navigation capability. In general, IGS provides increased precision in location determination and enables the utilization of enhancements in the capabilities of satellite navigation system devices. A Differential Global Positioning System (DGPS) is an enhancement of GPS that incorporates additional ground-based reference stations that allow the calculation of differences between the measured GPS positions and the ground-based fixed locations so that corrections can be made for improved accuracy. Accordingly, it should be understood that, as used herein, the term satellite navigation system is meant to encompass any of a number of different systems including, for example, GPS, IGS, GNSS, NAVSTAR, GLONASS, DGPS, etc.

[0023] In the depicted embodiment, the controller **103** is configured to access and/or receive at least one instruction set, which may derived or extracted from one or more research plans. Although the controller **103** may receive an instruction set in any manner, in the depicted embodiment, the controller **103** communicates with a data store **119,** which stores one or more instruction sets. Although not shown in the figure, in some embodiments, the system may also include a web server by which data from the data store **119** may be communicated over a network. It should be noted that although the controller **103** in the depicted embodiment is referred to as accessing and/or receiving at least one instruction set, which may be derived or extracted from one or more research plans, for the purposes of the current specification and appended drawings and claims, in some embodiments this may comprise accessing and/or receiving one or more research plans. According to various embodiments, information within an instruction set may include, but is not limited to, a map of the target seed locations in one or more research plots. Although the controller **103** of the depicted embodiment may communicate with the data store **119** over a network, in other embodiments the controller **103** may communicate directly with the data store **119.** It should be noted that for the purposes of the current specification and appended drawings and claims, the term data store may include, but is not limited to, a database, text file, relational database, or any other manner of storing data, including, for example, electronic memory.

[0024] As will be discussed in more detail below, in various embodiments one or more instruction sets may be used by the controller **103** to control the seed package handling device(s) **104** to release seed samples. In such a manner seed samples may be released into the seed metering device **108** and into the research plot according to instruction sets or research plans. In some embodiments, the instruction sets or research plans may be updated, such as, for example, by communicating changes

to the instruction sets over the network. Current manual processes do not monitor research plans and thus are not able to quickly and accurately change and adapt. For example, operators of manual prior art processes have no easy means of knowing when research plans are developed and/or altered and whether such development or alteration affects the disposition of seed samples in a particular research plot. By providing the controller **103** with access to one or more instruction sets associated with one or more research plans (such as, for example, by communication between the controller **103** and the data store **119**), various embodiments of the present invention may quickly adapt to changes in the one or more research plans or instruction sets associated therewith. Additionally, by providing the controller **103** with access to one or more instructions sets, various embodiments of the present invention may facilitate work flow management by prioritizing and/or otherwise managing the planting of seed samples.

[0025] Although in various embodiments the seed handling device may have different structures, **FIG. 4** shows a perspective view of a seed package assembly handling device **104** of a research seed planter **102** in accordance with one embodiment of the present invention. Such seed package assembly handling devices may include devices disclosed, for example, in U.S. Patent Publication No. 2009/0010750 assigned to the assignee of the present application and entitled "*Method of Handling Clamshell Containers Containing a Particulate Aliquot*". Generally, the seed package assembly handling device **104** of the depicted embodiment comprises the seed tray assembly **105,** a base plate **114,** first and second guide rails **116, 117,** an elevator assembly **118,** and a pusher assembly **120** (not visible in **FIG. 4**). The seed tray assembly **105** includes a row of columns **122** configured to hold a plurality of seed package assemblies **200.** Such seed package assemblies may include assemblies disclosed, for example, in U.S. Patent Publication No. 2008/0006627 assigned to the assignee of the present application and entitled *"Buckling Clamshell Container for Automated Aliquot and Dispersal Processes".* It should be noted that in other embodiments of the present invention, the seed package assembly handling device **104** may be configured to accommodate only one seed package assembly **200,** however providing capacity to accommodate a plurality of seed package assemblies **200** allows the research seed planter **102** to plant more seed in the research plot and/or to plant various seed varieties in the research plot.

[0026] The base plate **114** is located below the seed tray assembly **105,** with the guide rails **116, 117** mounted in a spaced parallel arrangement on top of the base plate **114,** such that the guide rails **116, 117** are disposed directly below the bottom of the seed tray assembly **105.** In the depicted embodiment, the seed tray assembly **105,** base plate **114,** guide rails **116,** elevator assembly **118,** and pusher assembly **120** of the depicted embodiment are constructed primarily of metal materials, such as steel and/or aluminum, however in other embodiments these components may be constructed of any other material(s) suitable for handling package assemblies, as described below.

[0027] The seed tray assembly **105** is oriented with the guide rails **116, 117** such that the bottom of each of the columns **122** is substantially aligned between the guide rails **116, 117.** Additionally, the seed tray assembly **105** is movable in a direction approximately aligned with arrow **A1** so that the bottom of each column **122** may be substantially aligned with a loading area **124** (better viewed in **FIG. 5**) defined by opposing recesses **126** created in the first and second guide rails **116,117.** The loading area **124** is configured to receive a package assembly **200** for moving along a seed package assembly handling path defined by the guide rails **116, 117.** The elevator assembly **118** is located below the loading area **124** and includes an elevating mechanism **127** which raises and lowers a pair of supports **128** in a direction approximately aligned with arrow **A2.** The supports **128** are located between the guide rails **116, 117** substantially aligned with the loading area **124.** The elevator assembly **118** is configured to move the supports **128** in a direction approximately aligned with arrow **A2.** In the depicted embodiment, the tray assembly **105,** the elevator assembly **118,** and the pusher assembly **120** are movable through pneumatic power by control of the controller **103,** however in other embodiments any one or any combination of the seed tray assembly **105,** elevator assembly **118,** or pusher assembly may be movable by other means, including, but not limited to, gear trains or screw drive systems driven by one or more electric motors controlled by the controller **103.**

[0028] Although the seed tray assembly **105** of the depicted embodiment is shown empty, each column **122** is configured to hold a plurality of seed package assemblies **200,** which may be stacked one on top of another in a closed position. So configured, the seed tray assembly **105** provides an array of closed package assemblies **200.** In the depicted embodiment, the seed tray assembly **105** comprises a single row of eight columns, with each column configured to hold twenty-eight to fifty seed package assemblies **200.** It should be noted that in other embodiments a column may be configured to hold any number of seed package assemblies **200.** Additionally, in other embodiments a tray assembly may comprise a variety of configurations designed to suit differing storage, space, and/or performance constraints, including, for example, a three-dimensional array having multiple rows and columns. In such embodiments, the tray assembly may be movable in other directions so as to substantially align the bottoms of the columns with a loading area. Alternatively, multiple loading areas may be available to receive package assemblies from the tray assembly.

[0029] **FIG. 5** shows a perspective view from a reverse angle of the seed package assembly handling device **104** in accordance with the exemplary embodiment of the invention depicted in **FIG. 4.** In this figure, the seed tray

assembly **105** and the second guide rail **117** have been removed to facilitate discussion. Each of the first and second guide rails **116, 117** includes a support surface **134** which defines the seed package assembly handling path and along which a seed package assembly **200** travels after being loaded from the tray assembly **105** into the loading area **124.** The pusher assembly **120** includes a pushing mechanism **130** that is configured to move a pair of pusher fingers **132** in a direction approximately aligned with arrow **A3.** The pusher fingers **132** are configured to move the seed package assembly **200** along the seed package assembly handling path. As will discussed in more detail below, the disengaging device **133** is configured to move in the general direction of **A2** to aid in opening a seed package assembly **200.** The pusher fingers **132** are located between the supports **128** and the pusher fingers **132** and the supports **128** move independent of, and do not interfere with, each other. A pinch area **135** is disposed in the first guide rail **116** along the support surface **134,** downstream from the loading area **124.** In some embodiments, the pinch area **135** is designed to apply a compressive force to the seed package assembly **200** as the seed package assembly **200** moves along the seed package assembly handling path. The pinch area **135** of the depicted embodiment is formed by a geometry of the first guide rail **116,** such that a portion of the first guide rail **116** extends out some distance from the first guide rail **116** toward the second guide rail **117** so that the guide rails **116, 117** converge and a compressive force is applied to the package assembly **200** as it moves along the seed package assembly handling path past the pinch area **135** by squeezing the package assembly **200** between the first and second guide rails **116, 117.** In various other embodiments, the pinch area **135** may be formed in a variety of ways including, but not limited to, a geometric configuration of the first and/or second guide rails that results in the first and second guide rails converging such that a compressive force is applied the seed package assembly; one or more pinch rollers defined by the first and/or second guide rails that extend inward so as to apply a compressive force to the seed package assembly; one or more actuated sections of the first and/or second guide rails wherein the one or more sections are configured to apply a compressive force to the package assembly when actuated inward; at least one adjustable insert or section located in one or both guide rails configured to deflect at least one of opposing sides of the seed package assembly, the insert or section being configured to adjust the amount of the compression force applied to the package assembly; and combinations thereof. In various embodiments, the mechanism(s) used to create the pinch area **135** may be configured to be deactivated by the controller, such as, for example, by retracting the mechanism(s) out of the path of the seed package assembly **200.** It should also be noted that in some embodiments, a compressive force need not be applied to the seed package assembly and thus there need not be a pinch area.

[0030] An opening tool **136** that includes a spear **138** defining a spear end **140** (shown in more detail in **FIG. 10**) is located between the guide rails **116, 117** downstream from the loading area **124** and is configured such that a package assembly **200** moving along the seed package assembly handling path contacts the spear end **140.** In the depicted embodiment, the opening tool **136** is constructed of a steel material, however in other embodiments it may be constructed of any material structured to facilitate opening of a seed package assembly **200.**

[0031] The seed package assembly sensor **112** may be located proximate the seed package assembly handling path and may be configured to read a label **201** containing indicia (or some other identifying medium) associated with each package assembly **200** before the seed package assembly **200** opens to release a research seed sample. In the depicted embodiment, the label **201** includes machine-readable and/or human-readable information relating to the research seed sample contained in the package assembly **200.** The seed package assembly sensor **112** may be any device capable of sensing information from the seed package assembly **200,** including, but not limited to, a barcode reader, an OCR reader, a radio frequency identification (RFID) reader capable of identifying an RFID transponder associated with the seed package assembly **200,** and/or a combination thereof. Additionally, although the seed package assembly sensor **112** of the depicted embodiment of the present invention is located proximate the seed package assembly handling path downstream from the loading area **124**, in other embodiments a seed package assembly sensor could be located in a variety of locations. For example, one or more seed package assembly sensors could be located on either side of the seed package assembly **200** or proximate the tray assembly **105**, the pusher assembly **120**, the elevator assembly **118**, and/or the opening tool **136.** In other embodiments, seed package assemblies could be sensed with a separate seed package assembly sensor prior to being loaded in the tray assembly **105**, such as, for example, a hand-held barcode scanner and/or RFID reader. However, it should be noted that not all embodiments of the present invention include a seed package assembly sensor.

[0032] Although in various embodiments of the present invention the seed package assemblies may have different structures (other structures may include, but are not limited to, pouches, bags, small boxes, etc.), **FIGS. 6** and **6A** show an exemplary seed package assembly **200** of a type that may be used in conjunction with the seed package assembly handling device **104** shown in **FIGS. 4** and **5** in accordance with one exemplary embodiment of the present invention. Specifically, **FIGS. 6** and **6A** show a perspective view of a seed package assembly **200**, in open and closed positions, respectively, which is usable in conjunction with the an exemplary embodiment of the present invention. As shown, the seed package assembly **200** may generally comprise a container por-

tion **210** defining an opening **220** and including at least two opposing sides **212**, **214**. The seed package assembly **200** may further comprise a cover portion **230** configured to cooperate with the container portion **210** to selectively close the opening **220** defined by the container portion **210**. It should be noted, however, that the method of handling package assemblies of various embodiments of the present invention described herein may operate on a variety of package assembly designs and thus the present invention should not be limited to use with the particular package assemblies those shown in the figures.

[0033] In order to effectively close the opening **220** defined by the container portion **210** of the depicted embodiment, the cover portion **230** may comprise a reinforcing ridge portion **240** operably engaged about a perimeter of the cover portion **230** and configured to be capable of engaging an inner periphery of the opening **220**, in an interference fit, so as to selectively close the opening **220,** such that the cover portion **230** is not easily disengaged from the container portion **210** without the application of a force, as described herein. It should be noted that in various embodiments, only a portion of the cover portion **230** and the container portion **210** may cooperate to hold the portions in a closed position. Moreover, an interference fit need not be required to hold the cover portion **230** in a closed position over the opening **220** of the container portion **210.** The method of various embodiments of the present invention is operable in conjunction with seed package assemblies of a variety of designs, some of which are configured so that first and second portions at least partially separate in response to a force applied to the seed package assembly. In such a manner, the first and second portions may separate, at least partially, in response to the force, thus releasing at least a portion of a particulate aliquot contained within the package assembly. Thus, for example, package assemblies of other embodiments may comprise independent first and second portions wherein when the portions separate, one of the portions falls away from the other. Additionally, an adhesive or heat sealing material may be used to hold the first and second portions (or a portion of the first and second portions) in a closed position, wherein the adhesive or sealing material is designed to fail when the package assembly is subjected to a force.

[0034] The reinforcing ridge portion **240** of the depicted embodiment may also define a pair of flexure channels **245**, **246** on opposing sides **231**, **233** of the cover portion **230.** Furthermore, the flexure channels **245**, **246** may cooperate to define a flexure axis **242** extending substantially perpendicularly to the opposing sides **231**, **233** of the cover portion **230** defining the flexure channels **245, 246** such that the flexure axis **242** is substantially parallel to the opposing sides **212, 214** of the container portion **210**.

[0035] According to various embodiments of the present invention, the container portion **210**, the cover portion **230**, and the opening **220** defined by the container portion may be formed into a variety of different shapes. For example, in some embodiments, the various components of the package assembly **200** may be formed in a substantially rectangular shape. In other embodiments the various components (such as the container portion **210**, cover portion **230**, and reinforcing ridge portion **240**) may be formed to have a variety of other shapes, including but not limited to: polygonal shapes (including, but not limited to rectangles, triangles, hexagons); circular; oval; semi-circular; and combinations of such shapes.

[0036] As shown in **FIG. 6**, the flexure channels **245, 246** defined in the reinforcing ridge portion **240** of the cover portion **230** may have different configurations on one side as compared to the other side. In other embodiments, the flexure channels **245, 246** may have the same configuration. In the depicted embodiment, flexure channel **245** has a partially rectangular cross-sectional shape and flexure channel **246** has a cross-sectional V-shape. According to other embodiments, the flexure channels **245**, **246** may also define various other cross-sectional shapes that may be tailored to define a flexure axis **242** extending substantially perpendicularly to the opposing sides **231, 233** of the cover portion **230.** For example, one or both of the flexure channels **245, 246** may, in some alternative embodiments, define cross-sectional shapes that may include, but are not limited to: partial rectangular; oval; circular; triangular; and combinations of such cross-sectional shapes. For example, in **FIGS. 11** and **12,** both flexure channels define half circular cross-sections. The shape of the cross-section of the flexure channels **245, 246** may thus be tailored to suit the material used to form the cover portion **230** and/or the reinforcing ridge portion **240** so as to define a distinct flexure axis **242** across a width of the cover portion **230** such that the cover portion flexes outwardly from the container portion **210** about the flexure axis **242** defined by the opposing flexure channels **245, 246** (see, for example, **FIG. 12,** showing the flexing action of the cover portion **230** about the flexure axis **242** in response to a compressive force applied to the seed package assembly **200**).

[0037] Thus, in the depicted embodiment the cover portion **230** may be configured to flex outwardly from the container portion **210** about the flexure axis **242,** when a compressive force is applied to at least one of two opposing sides **212, 214** of the container portion **210.** The compressive force may thus initiate the disengagement of the reinforcing ridge portion **240** from the inner periphery of the opening **220** so that the cover portion **230** disengages from the container portion **210.** The seed package assembly **200** of the depicted embodiment is inverted such that the cover portion **230** may drop away (see **FIG. 12**) from the container portion **210** after the reinforcing ridge portion **240** has been disengaged from the inner periphery of the opening **120** due to a compressive force applied to the opposing sides **212, 214** of the container portion **210.**

[0038] The seed package assembly **200** may thus be used to release one or more seeds **300** (such as a com-

prising a research seed sample) that have been segregated and contained within the container portion **210** of the seed package assembly **200** of the present invention. As described generally above, the seed package assembly **200** of various embodiments of the present invention may be advantageously opened by the simple application of a compressive force to at least one of the opposing sides **212, 214** of the container portion **210** of the package assembly **200** while suspending the package assembly **200** in an inverted position.

[0039] As shown generally in **FIG. 6A,** the seed package assembly **200** may further comprise a hinge portion **250** operably engaged between an edge of the cover portion **230** and one of the at least two opposing sides **212, 214** of the container portion **210** such that the cover portion **230** and the container portion **210** may form a substantially seed unitary package assembly **200** even when the cover portion **230** (and the reinforcing ridge portion **240** extending therefrom) is disengaged from the inner periphery of the opening **220** defined in the container portion **210** (as shown generally in **FIG. 11**). In some embodiments of the present invention, the hinge portion **250** may be integrally formed with one or both of the container portion **210** and the cover portion **230** to form a unitary seed package assembly **200.** According to some alternative embodiments, the hinge portion **250** may also be operably engaged with one or both of the container portion **210** and the cover portion **230** using an adhesive material in order to form the seed package assembly **200.** As described generally above, the hinge portion **250** may be formed with a bias towards the "open" position (as shown generally in **FIG. 11**) such that the hinge portion **250** may urge the cover portion **230** generally away from the container portion **210** once the compressive force has caused the initial disengagement of the reinforcing ridge portion **240** from an inner periphery of the opening **220** defined in the container portion **210.**

[0040] Furthermore, as shown generally in **FIGS. 6** and **6A,** the seed package assembly **200** may also comprise a pair of complementary flange portions **219, 232** extending outward from an outer periphery of the opening **220** and the reinforcing ridge portion **240** of the cover portion **230,** respectively. For example, the seed package assembly **200** may further comprise a first flange portion **219** extending substantially perpendicular from at outer periphery of the opening **220,** and a second flange portion **232** extending substantially outward from the reinforcing ridge **240** such that when the cover portion **230** closes the opening **220** defined by the container portion **210,** the first flange portion **219** is substantially adjacent and parallel to the second flange portion **232.** Furthermore, the second flange portion **232** may define a pair of opposing concave portions **235** substantially coaxial with the flexure axis **242.** According to such embodiments, the concave portions **235** may form a corresponding pair of apertures between the first and second flange portions **219, 232** when the cover portion **230** closes the opening **220** defined by the container portion **210.** For example, in some of such embodiments, the pair of apertures defined by the opposing concave portions **235** formed in the second flange portion **232** may be adapted to be capable of receiving an opening tool **136** (described in more detail with respect to **FIGS. 7-10**) for encouraging the cover portion **230** to flex outwardly from the container portion **210** about the flexure axis **242** so that the cover portion **230** disengages from the container portion **210.** In various embodiments, an opening tool may be any implement configured to aid in encouraging package assembly portions to separate, such as a screwdriver, knife, or other narrow-bladed implement, etc. Thus, such opposing concave portions **235** defined in by the second flange portion **232** may serve to define a corresponding pair of apertures between the flange portions **219, 232** so that the opening tool **136** may be inserted into the aperture located at or near the flexure axis **242** so as to further urge the cover portion **230** out of its interference fit with the container portion **210.** The package assembly **200** of the depicted embodiment also includes at least one corresponding concave portion **251** defined by the first flange portion **219.** The corresponding concave portion **251** is configured such that when the cover portion **230** is engaged with the container portion **210**, the container ridge **251** substantially aligns with one of the opposing concave portions **235** defined by the second flange portion **232.** In such a manner, the aligned concave portion **235** and corresponding concave portion **251** form a larger aperture between the first and second flange portions **219, 232** when the cover portion **230** closes the opening **220** defined by the container portion **210.** As a result, the aperture formed by the concave portion **235** and the corresponding concave portion **235** creates a larger target for receiving an opening tool for encouraging the cover portion **230** to flex outwardly from the container portion **210** about the flexure axis **242** so that the cover portion **230** disengages from the container portion **210.** It should be noted that in other embodiments, concave portions need not be included on the seed package assembly. For such embodiments, an opening tool may still be used to at least partially separate portions of a package assembly by inserting the opening tool between the portions.

[0041] A notch portion **253** is defined by the first flange portion **219** of the depicted embodiment. The notch portion **253** is configured to allow a disengaging device **133** (described in more detail with respect to **FIGS. 5-7**) to exert a force approximately normal to the second flange **232** through the notch portion **253.** In such a manner, the disengaging device **133** may further facilitate disengaging the cover portion **230** from the container portion **210.** In various embodiments, a disengaging device may be any device, tool, and/or mechanism configured to exert a force through the notch portion **253** against the second flange **232.** As such, in various embodiments a disengaging device may be used alone, or in combination with the opening tool **136** received in one or both of the pair of apertures defined by the opposing ridges **235.** As a

result, in various embodiments, this may increase opening success for packaging assemblies with dimensional variability. It should be noted that although the notch portion **253** shown in the depicted embodiment is generally rectangular in shape, one skilled in the art will recognize that a notch portion in accordance with the present invention may take many other shapes, including, but not limited to, a half circular shape, a half oval shape, a triangular shape, a circular shape, an oval shape, and combinations thereof. It should also be noted that in various embodiments, the disengaging device **133** may be deactivated by the controller **103** such as, for example, by not actuating the disengaging device **133** so that it does not act upon the seed package assembly **200.**

[0042] **FIGS. 7-9** depict a method of opening seed package assemblies **200** in accordance with various exemplary embodiments of the present invention. In these figures, the tray assembly **105** and the second guide rail **117** have been removed to facilitate discussion. The method of handling package assemblies of various embodiments of the present invention may handle one or a plurality of package assemblies. Referring to depicted embodiment of **FIG. 7**, although a single seed package assembly **200** is shown, the description assumes that a stack of seed package assemblies exists above the depicted seed package assembly **200.** The process begins with the tray assembly **105** moving such that a column **122** containing a stack of package assemblies is aligned with the loading area **124,** which is defined by opposing recessed areas **126** located in the first and second guide rails **116, 117.** The distance between the first and second guide rails **116, 117** in the loading area **124** is configured to be slightly greater than the length of the seed package assembly **200.** In this manner, the supports **128** may move into contact with the bottommost seed package assembly **200** and the stack of seed package assemblies may be moved up and down by the elevating mechanism **127** proximate the loading area **124**. Once a stack of seed package assemblies has been moved by the tray assembly **105** into a position approximately aligned with the loading area **124**, the elevating mechanism **127** moves the supports **128** into contact with the bottommost seed package assembly **200**. The entire stack of package assemblies is then moved downward so that the flanges **219, 232** of the bottommost seed package assembly **200** approximately align with the support surfaces **134** of the first and second guide rails **116, 117.** As the elevating mechanism **127** lowers the stack of package assemblies, the label **201** of the seed bottommost package assembly **200** may be sensed by the seed package assembly sensor **112** (not shown). In this manner, information pertaining to the bottommost seed package assembly **200**, which is the seed package assembly entering the seed package assembly handling path, may be recorded. As the elevating mechanism **127** continues to lower the stack of package assemblies, the flanges **219, 232** of the bottommost seed package assembly **200** contact the support surfaces **134** of the first and second guide rails **116,117.** As shown in **FIG. 6A**, in some embodiments the length of second flange portion **232** may be shorter than the length of first flange portion **219** so that when the seed package assembly **200** is lowered onto the support surfaces **134**, the first flange portion **219** contacts the support surface **134** of the second guide rail **117** so that the cover portion **230** may be free to separate from the container portion **210** upon application of a force.

[0043] In **FIG. 8**, the pushing mechanism **130** (not shown) moves the pusher fingers **132** into contact with the bottommost seed package assembly **200** such that the seed package assembly **200** may be pushed out from the bottom of the stack of package assemblies, along the seed package assembly handling path. The top surfaces of the pusher fingers **132** are configured so that as the pusher fingers **132** move the bottommost seed package assembly **200** out from under the stack of seed package assemblies and along the seed package assembly handling path, the remaining stack of seed package assemblies rides on top of the pusher fingers **132.** Once the pusher fingers **132** move past the stack of seed package assemblies, the elevating mechanism **127** moves the supports **128** upward, lifting the stack of seed package assemblies off of the pusher fingers **132**. The pushing mechanism **130** then continues to drive the pusher fingers **132**, thus moving the seed package assembly **200** along the seed package assembly handling path defined by the support surfaces **134**, past the pinch area **135**. As noted above, the pinch area **135** extends out some distance from the first guide rail **116** toward the second guide rail **117** such that as the seed package assembly **200** passes the pinch area **135,** pressure is exerted on surface **244** of the seed package assembly **200**, and the seed package assembly **200** is forced against the second guide rail **117** and is thus subjected to a compressive force. In the depicted embodiment, the compressive force is applied against the hinge portion **250** and surface **244** on the opposite end of the seed package assembly **200.** As such the compressive force is applied approximately perpendicular to the flexure axis **242.** The compressive force causes the cover portion **230** of the seed package assembly **200** to flex outwardly from the container portion **210** about the flexure axis **242,** which causes the cover portion **230** of the package assembly **200** to bow downward (as shown, for example, in **FIG. 11**). In some embodiments, this compressive force initiates the disengagement of the reinforcing ridge portion **240** from the inner periphery of the opening **220** so that the cover portion **230** disengages from the container portion **210.** As shown in **FIG. 12,** in such embodiments the cover portion **230** drops away from the container portion **210** after the reinforcing ridge portion **240** has been disengaged from the inner periphery of the opening **220.** It should be noted that in other embodiments, no compressive force is applied to the seed package assembly **200** and separation of the cover portion **230** and container portion **210** occurs via application of one or more different forces.

[0044] In some embodiments, such as the depicted embodiment, additional devices and/or mechanisms may be used to apply a force to the seed package assembly **200** to further encourage the cover portion **230** to disengage from the container portion **210**. Referring to **FIG. 9**, once the cover portion **230** is bowed about the flexure axis **242**, the pushing mechanism **130** drives the pusher fingers **132** to move the seed package assembly **200** such it engages an opening tool **136** (shown by itself in **FIG. 10**). In particular, the seed package assembly **200** is moved along the seed package assembly handling path such that an existing aperture defined by one of the opposing concave portions **235** and corresponding concave portion **251** of the seed package assembly **200** contacts the spear end **140** of the opening tool **136.** In the depicted embodiment, the opening tool **136** is rigidly attached to the second guide rail **117** such that as the seed package assembly **200** continues to move along the seed package assembly handling path, the spear **138** inserts between the cover portion **230** and the container portion **210** of the seed package assembly **200.** However in other embodiments, the opening tool **136** may be secured to various other structures of the seed package assembly handling device **104** in various different manners, and in some embodiments, the opening tool **136** may be configured to be deactivated by the controller, such as, for example, by retracting the opening tool **136** out of the path of the seed package assembly **200.**

[0045] Concurrently, in the depicted embodiment a disengaging tool **133**, which is located between the pusher fingers **132**, is actuated via pneumatic power, however in other embodiments the disengaging tool **133** may be actuated in various other ways, and in some embodiments there need not be a disengaging tool **133.** Once actuated, the disengaging tool **133** of the depicted embodiment is configured to push downward through the notch portion **253** defined by the first flange portion **219** of the package assembly **200**. In such a manner, the disengaging device **133** exerts a force approximately normal to the second flange **232** through the notch portion **253** further encouraging the cover portion **230** to disengage from the container portion **210.** Thus, in the depicted embodiment, the opening tool **136** and the disengaging tool **133** ensure that the cover portion **230** completely disengages from the container portion **210.**

[0046] If, as shown in the figures, the seed package assembly **200** is inverted, the cover portion **230** may drop away from the container portion **210** after the reinforcing ridge portion **240** has been disengaged from the inner periphery of the opening **220.** Once the cover portion **230** has disengaged from the container portion **210,** a deflecting arm **142** of the opening tool **136** deflects the cover portion **230** such that it is held away from the container portion. As shown generally in **FIG. 12**, the package assembly **200** may thus be used to release the research seed sample **300** contained within the container portion **210** of the seed package assembly **200.**

[0047] It should be noted that although the depicted embodiments show a method in which portions of a seed package assembly are at least partially separated by applying several forces to the package assembly (i.e., applying a compressive force to opposing sides of the package assembly, inserting an opening tool between portions of the package assembly, and applying an approximately normal force to a flange defined in one portion of the package assembly), in other embodiments a seed package assembly may be at least partially separated by applying any one force to the seed package assembly or any combination of forces to the seed package assembly. Additionally, although the depicted embodiments show a method in which portions of a package assembly are at least partially separated by applying several forces to the seed package assembly as the package assembly moves along a package assembly handling path, in other embodiments any one force may be applied to the package assembly or any combination of forces may be applied to the package assembly without requiring the package assembly to move along a package assembly handling path. That is, in other embodiments any one force or any combination of forces adapted to at least partially separate portions of a package assembly may act on an unmoving package assembly.

[0048] For various reasons, the seed package assembly handling device **104** may also be capable of bypassing the dispensing operation with respect to one or more of the seed package assemblies **200.** For example, the controller **103** may control the seed package assembly handling device **104** to deactivate the mechanism(s) causing the opening force(s). In various embodiments, the controller **103** may control the seed package assembly handling device **104** not to open a seed package assembly **200** if, for example, the controller **103** receives information read from the seed package assembly **200** by the seed package assembly sensor **112** that is not consistent with information expected of the seed package assembly **200.** In particular, when bypassing is desired, the controller **103** may control the seed package assembly handling device **104** to deactivate the mechanism(s) that create opening force(s), which may include, for example, retracting the mechanism(s) that create the pinch area **135**, deactivating the disengaging device **133**, and/or retracting the opening tool **136**. In such a manner, the seed package assembly **200** may travel from the seed tray assembly **105** to the waste container **111** without being opened.

[0049] **FIGS. 13** and **14** show a front perspective view and a rear prospective view, respectively, of an automated research seed planting system **100** that includes a mobile planter transport device **99** and a research seed planter **102** in accordance with an exemplary embodiment of the present invention. In the depicted embodiment, the research seed planter **102** is configured to be transported via the mobile planter transport device **99** and is configured to plant four rows of seed in a research plot for each pass of the research seed planter **102.** The research seed planter **102** of the depicted embodiment

includes four seed package handling devices **104,** and four seed metering devices **108,** with a seed package handing device **104** and a seed metering device **108** being associated with each of the four rows to be planted. In the depicted embodiment, the research seed planting system **100** also includes a positional data acquisition system **115** (not visible in **FIGS. 13** and **14**) configured to acquire position data associated with one or more research seed planting events. The research seed planter **102** of the depicted embodiment also includes a seed package assembly sensor **112** (not visible in **FIGS. 13** and **14**), associated with each of the seed package assembly handling devices **104,** for sensing information pertaining to the seed package assemblies **200,** and a seed drop sensor **113** (not visible in **FIGS. 13** and **14**) for sensing seed drop events. As a result, specific locations within the research plot where a particular seed package was released into a respective seed metering device and/or specific locations in the research plot where individual seeds from a particular seed package were released into the research plot can be determined. In some embodiments, these locations may be compared to one or more instruction sets or research plans and/or may be used to update one or more instruction sets and/or research plans. In other embodiments, these seed drop events may be triggered as a result of the position of the research seed planter **102** in the research seed plot.

[0050] **FIG. 15** shows a research seed planter **102** in accordance with another exemplary embodiment of the present invention. In the depicted embodiment, the research seed planter **102** is configured to be transported via a mobile planter transport device (not visible in **FIG. 15**) and is configured to plant eight rows of seed in a research plot for each pass of the research seed planter **102.** The eight rows of seed are supplied by four seed package handling devices **104,** each one being dedicated for adjacent pairs of the eight rows to be planted. In the depicted embodiment, the orientations of the seed package handling devices **104** are rotated with respect to the research seed planter **102** but are otherwise configured similarly as explained with respect to **FIG. 2**, with each seed package handing device having a seed tray assembly **105** configured to carry one or more seed package assemblies **200** that are configured to contain a research seed sample comprising one or more seeds. **FIG. 16** shows a schematic drawing of portions of a similar research seed planter in accordance with an exemplary embodiment of the present invention. In particular, **FIG. 16** shows some of the components associated with each pair of rows to be planted including a seed dispensing device **104**, a seed handling splitter **199**, a pair of seed metering devices **108,** a pair of seed drop tubes **110**, a pair of seed package assembly sensors **112**, and a pair of seed meter sensors **113.** As shown in the drawing, each seed dispensing device **104** automatically opens associated seed package assemblies **200** and releases research seed samples into the seed handling splitter **199**, which directs the seed into the pair of respective seed metering devices **108.** In various embodiments a precision seed splitter may be used, such as, for example, as is available from many commercial sources, including ALMACO of Nevada, Iowa. As similarly described above, the seed metering devices **108** receive the seeds released by the seed package handling device **104** and singulate the seeds. Individual seeds are then released by the seed metering device through a drop tube **110** and into the research plot.

[0051] Although the embodiment depicted in **FIG. 16** employs two-way splitters, it should be noted that in other embodiments, other types of splitters may be used, including four-way and eight-way splitters, etc. Additionally, in other embodiments groups of seed package handling devices may be associated with the same splitter so as to provide increased capacity. For example, in one embodiment four pairs of seed handling devices are provided in an eight row planter with each pair of seed handling devices being associated with a two-way splitter. In such a manner, each row to be planted is supplied by one of two seed handling devices, allowing one of the two seed handling devices to empty all of its seed package assemblies before the other of the two seed handling devices starts to empty its seed package assemblies.

[0052] Many modifications and other embodiments of the invention set forth herein will come to mind to one skilled in the art to which this invention pertains having the benefit of the teachings presented in the foregoing descriptions and the associated drawings. Therefore, it is to be understood that the invention is not to be limited to the specific embodiments disclosed and that modifications and other embodiments are intended to be included within the scope of the appended claims. Although specific terms are employed herein, they are used in a generic and descriptive sense only and not for purposes of limitation.

Claims

1. An automated research seed planting system (100), the system comprising:

   a planter (102) configured for planting a research plot and comprising a seed package assembly handling device (104) comprising a seed tray assembly (105) configured to hold a plurality of seed package assemblies (200), each seed package assembly containing a research seed sample; and

   a controller (103) configured to communicate with the seed package assembly handling device (104),

   wherein the controller (103) is configured to control the seed package assembly handling device (104) to automatically release the research seed sample from the seed package assembly (200).

2. The automated research seed planting system (100) according to Claim 1, wherein the controller (103) is further configured to automatically control the seed package handling device (104) to apply a force to the seed package assembly to release the research seed sample from the seed package assembly (200).

3. The automated research seed planting system (100) according to Claim 1, wherein the seed package assembly (200) includes at least one of a machine-readable or human-readable label (201).

4. The automated research seed planting system (100) according to Claim 1, further comprising a positional data acquisition device (115) configured to acquire position data and wherein the controller (103) is configured to control the seed package assembly handling device (104) according to the position data and one or more instruction sets, preferably wherein one or more instructions sets are derived from one or more research plans, more preferably wherein at least one of the research plans or the instruction sets are stored in at least one data store.

5. The automated research seed planting system (100) according to Claim 1, wherein the planter (102) comprises a plurality of seed package assembly handling devices (104) each configured to receive a respective seed package assembly of a plurality of seed package assemblies (200), and wherein one or more controllers (103) are configured to automatically control each seed package assembly handling device to release a respective research seed sample into the research plot, preferably either (a) wherein the planter (102) further comprises a plurality of seed metering devices (108) each configured to receive a respective research seed sample from a respective seed package assembly handling device (104), and wherein each seed metering device (108) is further configured to separate individual seeds from the respective research seed sample and to release the individual seeds into the research plot, preferably further comprising a plurality of seed meter sensor devices (113) configured to sense individual seeds as the individual seeds are released into the research plot, or (b) wherein the planter (102) is configured to plant four rows and comprises four seed package assembly handling devices and four respective seed metering devices, and wherein each seed package assembly handling device (104) is configured to release at least a portion of a respective seed sample into a respective seed metering device, or (c) wherein the planter (102) is configured to plant eight rows and comprises four seed package assembly handling devices, four seed sample splitting devices, and eight seed metering devices (108), and wherein each seed package assembly handling device (104) is configured to release at least a portion of a respective seed sample into a respective pair of the eight seed metering devices (104) via a respective seed sample splitting device.

6. The system of Claim 2, wherein the seed package assembly handling device (104) is configured to open a seed package assembly (200) comprising first and second portions that cooperate to contain the research seed sample, and wherein the seed package assembly handling device is configured to apply a force to the seed package assembly (200) so that the first and second portions of the seed package assembly at least partially separate thus releasing the research seed sample.

7. The system of claim 1, wherein the controller is configured to control the seed package assembly handling device to bypass releasing the research seed sample from the seed package assembly (200).

8. The automated research seed planting system according to Claim 6, wherein the force comprises at least a compressive force and wherein the compressive force causes at least one of the first or second portions of the seed package assembly to flex outwardly from the other portion about a flexure axis so that the first and second portions at least partially separate in response to the force, thus releasing the research seed sample, preferably wherein the seed package assembly handling device further comprises an opening tool and a disengaging tool, and wherein the controller is further configured to cause the opening tool to contact between the first and second portions of the seed package assembly and to automatically control the seed package assembly handling device to apply a second force to the package assembly via the disengaging tool, for encouraging at least one of the first or second portions to flex outwardly from the other portion about the flexure axis so that the first and second portions separate.

9. The system of claim 1, wherein the seed package assembly handling device (104) is configured to be controlled according to one or more instruction sets, preferably wherein the one or more instructions sets are derived from one or more research plans and optionally at least one of the research plans or the instruction sets are stored in at least one data store (119).

10. The automated research seed planting system (100) according to Claim 6, wherein either (a) the seed package assembly handling device (104) further comprises an opening tool (136) configured to contact the seed package assembly (200) between the first and second portions and wherein the force comprises a force exerted by the opening tool (136) on

the seed package assembly (200), or (b) wherein the force comprises at least a compressive force and wherein the compressive force causes at least one of the first or second portions of the seed package assembly (200) to flex outwardly from the other portion about a flexure axis so that the first and second portions at least partially separate in response to the force, thus releasing the research seed sample, preferably wherein the seed package assembly handling device (104) further comprises an opening tool (136) and a disengaging tool (133), and wherein the opening tool (136) is configured to contact the seed package assembly (200) between the first and second portions of the seed package assembly (200) so as to apply a second force to the seed package assembly (200) and the disengaging tool (136) is configured to apply a third force to the seed package assembly (200), and wherein the compressive force and the second and third forces encourage at least one of the first or second portions to flex outwardly from the other portion about the flexure axis so that the first and second portions separate, or (c) further comprising a positional data acquisition device (115) configured to acquire position data and wherein the seed package assembly handling device (104) is configured to operate according to the position data and one or more instruction sets, or further comprising a seed sample splitting device configured to receive the research seed sample from the seed package assembly handling device (104).

11. The system of Claim 3, further comprising a seed package assembly sensor device (112) configured for reading a label (201) of the seed package assembly (200), preferably wherein the seed package assembly sensor device (112) comprises a device selected from the group consisting of:

a bar code reader;
an OCR reader;
an RFID reader; and
combinations thereof, or
further comprising a positional data acquisition device (115) configured to acquire position data relating to a position of the released research seed sample.

12. The system of Claim 1, further comprising a seed metering device (108) configured to receive the research seed sample from the seed package assembly handling device (104), and wherein the seed metering device (108) is configured to separate individual seeds from the research seed sample and to release the individual seeds into the research plot, preferably further comprising a seed meter sensor device (113) configured to sense individual seeds as the individual seeds are released into the research plot.

13. A method of planting a research plot, said method comprising:

transporting a planter (102) that comprises a seed package assembly handling device (104) comprising a seed tray assembly (105) that holds a plurality of seed package assemblies (200) each seed package assembly containing a research seed sample;
moving a seed tray assembly (105) to align the seed package assembly (200) with a loading area (124); and
controlling the seed package assembly handling device (104) using a controller (103) to automatically release the research seed sample.

Patentansprüche

1. Automatisiertes Pflanzsystem (100) für Forschungssaatgut, wobei das System aufweist:

eine Pflanzmaschine (102), die für das Bepflanzen einer Forschungsparzelle ausgebildet ist und eine Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen aufweist, die eine Saatgutmuldenanordnung (105) aufweist, die ausgebildet ist, um eine Vielzahl von Anordnungen (200) von Saatgutpackungen aufzunehmen, wobei eine jede Anordnung von Saatgutpackungen eine Saatgutprobe für Forschungszwecke enthält; und
einen Regler (103), der ausgebildet ist, um mit der Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen in Verbindung zu stehen,
wobei der Regler (103) ausgebildet ist, um die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen zu steuern, um automatisch die Saatgutprobe für Forschungszwecke aus der Anordnung (200) von Saatgutpackungen freizugeben.

2. Automatisiertes Pflanzsystem (100) für Forschungssaatgut nach Anspruch 1, bei dem der Regler (103) außerdem ausgebildet ist, um die Handhabungsvorrichtung (104) für Saatgutpackungen automatisch zu steuern, um eine Kraft auf die Anordnung von Saatgutpackungen auszuüben, um die Saatgutprobe für Forschungszwecke aus der Anordnung (200) von Saatgutpackungen freizugeben.

3. Automatisiertes Pflanzsystem (100) für Forschungssaatgut nach Anspruch 1, bei dem die Anordnung (200) von Saatgutpackungen mindestens eines von einem maschinell lesbaren oder vom Menschen lesbaren Etikett (201) umfasst.

4. Automatisiertes Pflanzsystem (100) für Forschungssaatgut nach Anspruch 1, das außerdem eine Erfassungsvorrichtung (115) für Positionsdaten aufweist, die ausgebildet ist, um Positionsdaten zu erfassen, und wobei der Regler (103) ausgebildet ist, um die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen entsprechend den Positionsdaten und einem oder mehreren Befehlssätzen zu steuern, vorzugsweise, bei dem ein oder mehrere Befehlssätze aus einem oder mehreren Forschungsprojekten abgeleitet werden, mehr bevorzugt, bei dem mindestens eines der Forschungsprojekte oder die Befehlssätze in mindestens einem Datenspeicher gespeichert werden.

5. Automatisiertes Pflanzsystem (100) für Forschungssaatgut nach Anspruch 1, bei dem die Pflanzmaschine (102) eine Vielzahl von Handhabungsvorrichtungen (104) mit einer Anordnung von Saatgutpackungen aufweist, von denen eine jede ausgebildet ist, um eine entsprechende Anordnung von Saatgutpackungen aus einer Vielzahl von Anordnungen (200) von Saatgutpackungen aufzunehmen, und wobei ein oder mehrere Regler (103) ausgebildet sind, um jede Handhabungsvorrichtung mit einer Anordnung von Saatgutpackungen automatisch zu steuern, um eine entsprechende Saatgutprobe für Forschungszwecke in die Forschungsparzelle abzugeben, vorzugsweise entweder (a), wobei die Pflanzmaschine (102) außerdem eine Vielzahl von Dosiervorrichtungen (108) für Saatgut aufweist, von denen eine jede ausgebildet ist, um eine entsprechende Saatgutprobe für Forschungszwecke aus einer entsprechenden Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen aufzunehmen, und wobei eine jede Dosiervorrichtung (108) für Saatgut weiter ausgebildet ist, um die einzelnen Saatgüter von der entsprechenden Saatgutprobe für Forschungszwecke zu trennen und die einzelnen Saatgüter in die Forschungsparzelle abzugeben, wobei sie vorzugsweise außerdem eine Vielzahl von Sensorvorrichtungen (113) für die Saatgutdosierung aufweist, die ausgebildet sind, um die einzelnen Saatgüter zu erfassen, während die einzelnen Saatgüter in die Forschungsparzelle abgegeben werden, oder (b), wobei die Pflanzmaschine (102) ausgebildet ist, um vier Reihen zu pflanzen und vier Handhabungsvorrichtungen mit einer Anordnung von Saatgutpackungen und vier entsprechende Dosiervorrichtungen für Saatgut aufweist, und wobei eine jede Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen ausgebildet ist, um mindestens einen Teil der entsprechenden Saatgutprobe in eine entsprechende Dosiervorrichtung für Saatgut abzugeben, oder (c), wobei die Pflanzmaschine (102) ausgebildet ist, um acht Reihen zu pflanzen und vier Handhabungsvorrichtungen mit einer Anordnung von Saatgutpackungen, vier Aufteilvorrichtungen für die Saatgutprobe und acht Dosiervorrichtungen (108) für Saatgut aufweist, und wobei eine jede Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen ausgebildet ist, um mindestens einen Teil einer entsprechenden Saatgutprobe in ein entsprechendes Paar der acht Dosiervorrichtungen (108) für Saatgut über eine entsprechende Aufteilvorrichtung für die Saatgutprobe abzugeben.

6. System nach Anspruch 2, bei dem die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen ausgebildet ist, um eine Anordnung (200) von Saatgutpackungen zu öffnen, die einen ersten und einen zweiten Teil aufweist, die zusammenwirken, um die Saatgutprobe für Forschungszwecke aufzunehmen, und wobei die Handhabungsvorrichtung mit einer Anordnung von Saatgutpackungen ausgebildet ist, um eine Kraft auf die Anordnung (200) von Saatgutpackungen anzuwenden, damit sich der erste und der zweite Teil der Anordnung von Saatgutpackungen mindestens teilweise trennen, wodurch die Saatgutprobe für Forschungszwecke freigegeben wird.

7. System nach Anspruch 1, bei dem der Regler ausgebildet ist, um die Handhabungsvorrichtung mit einer Anordnung von Saatgutpackungen zu steuern, um das Freigeben der Saatgutprobe für Forschungszwecke aus der Anordnung (200) von Saatgutpackungen zu umgehen.

8. Automatisiertes Pflanzsystem für Forschungssaatgut nach Anspruch 6, bei dem die Kraft mindestens eine Druckkraft aufweist, und wobei die Druckkraft bewirkt, dass sich mindestens einer von erstem oder zweitem Teil der Anordnung von Saatgutpackungen nach außen weg vom anderen Teil um eine Biegeachse biegt, so dass sich der erste und zweite Teil mindestens teilweise als Reaktion auf die Kraft trennen, wodurch die Saatgutprobe für Forschungszwecke freigegeben wird, wobei vorzugsweise die Handhabungsvorrichtung mit einer Anordnung von Saatgutpackungen außerdem ein Öffnungswerkzeug und ein Trennwerkzeug aufweist, und wobei der Regler außerdem ausgebildet ist, damit das Öffnungswerkzeug zwischen dem ersten und zweiten Teil der Anordnung von Saatgutpackungen einen Kontakt bewirkt, und damit die Handhabungsvorrichtung mit einer Anordnung von Saatgutpackungen automatisch gesteuert wird, um eine zweite Kraft auf die Anordnung von Packungen mittels des Trennwerkzeuges anzuwenden, damit mindestens einer von erstem oder zweitem Teil dabei unterstützt wird, sich vom anderen Teil um die Biegeachse nach außen zu biegen, so dass sich der erste und zweite Teil trennen.

9. System nach Anspruch 1, bei dem die Handha-

bungsvorrichtung mit einer Anordnung von Saatgutpackungen so ausgebildet ist, dass sie entsprechend einem oder mehreren Befehlssätzen gesteuert wird, wobei vorzugsweise der eine oder mehrere Befehlssätze von einem oder mehreren Forschungsprojekten abgeleitet werden, und wobei wahlweise mindestens eines der Forschungsprojekte oder die Befehlssätze in mindestens einem Datenspeicher (119) gespeichert werden.

10. Automatisiertes Pflanzsystem (100) für Forschungssaatgut nach Anspruch 6, bei dem entweder (a) die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen außerdem ein Öffnungswerkzeug (136) aufweist, das ausgebildet ist, um die Anordnung (200) von Saatgutpackungen zwischen dem ersten und zweiten Teil in Kontakt zu bringen, und wobei die Kraft eine Kraft aufweist, die durch das Öffnungswerkzeug (136) auf die Anordnung (200) von Saatgutpackungen ausgeübt wird, oder bei dem (b) die Kraft mindestens eine Druckkraft aufweist, und wobei die Druckkraft bewirkt, dass sich mindestens einer von erstem oder zweitem Teil der Anordnung (200) von Saatgutpackungen nach außen vom anderen Teil um eine Biegeachse biegt, so dass sich der erste und der zweite Teil mindestens teilweise als Reaktion auf die Kraft trennen, wodurch die Saatgutprobe für Forschungszwecke freigegeben wird, wobei vorzugsweise die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen außerdem ein Öffnungswerkzeug (136) und ein Trennwerkzeug (133) aufweist, und wobei das Öffnungswerkzeug (136) ausgebildet ist, um die Anordnung (200) von Saatgutpackungen zwischen dem ersten und zweiten Teil der Anordnung (200) von Saatgutpackungen in Kontakt zu bringen, um so eine zweite Kraft auf die Anordnung (200) von Saatgutpackungen anzuwenden, und wobei das Trennwerkzeug (136) ausgebildet ist, um eine dritte Kraft auf die Anordnung (200) von Saatgutpackungen anzuwenden, und wobei die Druckkraft und die zweite und die dritte Kraft dabei unterstützen, dass sich mindestens einer von erstem oder zweitem Teil vom anderen Teil um die Biegeachse nach außen biegen, so dass sich der erste und zweite Teil trennen, oder das (c) außerdem eine Erfassungsvorrichtung (115) für Positionsdaten aufweist, die ausgebildet ist, um Positionsdaten zu erfassen, und wobei die Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen ausgebildet ist, um entsprechend den Positionsdaten und einem oder mehreren Befehlssätzen zu arbeiten, oder das außerdem eine Aufteilvorrichtung für die Saatgutprobe aufweist, die ausgebildet ist, um die Saatgutprobe für Forschungszwecke von der Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen zu empfangen.

11. System nach Anspruch 3, das außerdem eine Sensorvorrichtung (112) für die Anordnung von Saatgutpackungen aufweist, die für das Lesen eines Etikettes (201) der Anordnung (200) von Saatgutpackungen ausgebildet ist, wobei vorzugsweise die Sensorvorrichtung (112) für die Anordnung von Saatgutpackungen ein Gerät aufweist, das ausgewählt wird aus der Gruppe, die besteht aus:

einem Strichcodelesegerät;
einem OCR-Lesegerät;
einem RFID-Lesegerät; und
Kombinationen davon, oder
das außerdem eine Erfassungsvorrichtung (115) für Positionsdaten aufweist, die ausgebildet ist, um Positionsdaten betreffs einer Position der freigegebenen Saatgutprobe für Forschungszwecke zu erfassen.

12. System nach Anspruch 1, das außerdem eine Dosiervorrichtung (108) für Saatgut aufweist, die ausgebildet ist, um die Saatgutprobe für Forschungszwecke von der Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen aufzunehmen, und wobei die Dosiervorrichtung (108) für Saatgut ausgebildet ist, um die einzelnen Saatgüter von der Saatgutprobe für Forschungszwecke zu trennen und die einzelnen Saatgüter in die Forschungsparzelle abzugeben, wobei sie vorzugsweise außerdem eine Sensorvorrichtung (113) für die Saatgutdosierung aufweist, die ausgebildet ist, um die einzelnen Saatgüter zu erfassen, während die einzelnen Saatgüter in die Forschungsparzelle abgegeben werden.

13. Verfahren zum Bepflanzen einer Forschungsparzelle, wobei das Verfahren die folgenden Schritte aufweist:

Transportieren einer Pflanzmaschine (102), die eine Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen aufweist, die eine Saatgutmuldenanordnung (105) aufweist, die eine Vielzahl von Anordnungen (200) von Saatgutpackungen aufnimmt, wobei eine jede Anordnung von Saatgutpackungen eine Saatgutprobe für Forschungszwecke enthält;
Bewegen einer Saatgutmuldenanordnung (105), um die Anordnung (200) von Saatgutpackungen mit einem Zuführbereich (124) auszurichten; und
Steuern der Handhabungsvorrichtung (104) mit einer Anordnung von Saatgutpackungen bei Benutzung eines Reglers (103), um die Saatgutprobe für Forschungszwecke automatisch freizugeben.

Revendications

1. Système de recherche de plantation de semences automatisé (100), le système comprenant :

   un semoir (102), destiné à assurer la plantation d'une parcelle de recherche, et comprenant un dispositif de manutention d'assemblages de sachet de semences (104), comprenant un assemblage de plateau de semences (105), destiné à retenir plusieurs assemblages de sachet de semences (200), chaque assemblage de sachet de semences contenant un échantillon de semences de recherche ; et
   un dispositif de commande (103), destiné à communiquer avec le dispositif de manutention des assemblages de sachet de semences (104) ;
   dans lequel le dispositif de commande (103) est destiné à contrôler le dispositif de manutention des assemblages de sachet de semences (104) pour libérer automatiquement l'échantillon de semences de recherche de l'assemblage de sachet de semences (200).

2. Système de plantation de semences de recherche automatisé (100) selon la revendication 1, dans lequel le dispositif de commande (103) est en outre destiné à contrôler automatiquement le dispositif de manutention des sachets de semences (104) pour appliquer une force à l'assemblage de sachet de semence afin de libérer l'échantillon de semences de recherche de l'assemblage de sachet de semences (200).

3. Système de plantation de semences de recherche automatisé (100) selon la revendication 1, dans lequel l'assemblage de sachet de semences (200) englobe au moins une étiquette lisible par une machine ou lisible par l'homme (201).

4. Système de plantation de semences de recherche automatisé (100) selon la revendication 1, comprenant en outre un dispositif d'acquisition de données de position (115), destiné à acquérir des données de position, et dans lequel le dispositif de commande (103) est destiné à contrôler le dispositif de manutention des assemblages de sachet de semences (104) sur la base des données de position et d'un ou de plusieurs ensembles d'instructions, dans lequel un ou plusieurs ensembles d'instructions sont dérivés de préférence d'un ou de plusieurs plans de recherche, et dans lequel au moins un des plans de recherche ou des ensembles d'instructions est stocké de manière plus préférée dans au moins un magasin de données.

5. Système de plantation de semences de recherche automatisé (100) selon la revendication 1, dans lequel le semoir (102) comprend plusieurs dispositifs de manutention des assemblages de sachet de semences (104), destinés chacun à recevoir un assemblage de sachet de semences respectif de plusieurs assemblages de sachet de semences (200), et dans lequel un ou plusieurs dispositifs de commande (103) sont destinés à contrôler automatiquement chaque dispositif de manutention des assemblages de sachet de semences afin de libérer un échantillon de semences de recherche respectif dans la parcelle de recherche, de préférence soit dans lequel (a) le semoir (102) comprend en outre plusieurs dispositifs de dosage des semences (108), destinés chacun à recevoir un échantillon de semences de recherche respectif d'un dispositif de manutention des assemblages de sachet de semences (104), et dans lequel chaque dispositif de dosage des semences (108) est en outre destiné à séparer les semences individuelles des échantillons de semences de recherche et à libérer les semences individuelles dans la parcelle de recherche, et comprenant de préférence en outre un ou plusieurs dispositifs de détection du dosage des semences (113), destinés à détecter des semences individuelles lors de la libération des semences individuelles dans la parcelle de recherche, ou (b) dans lequel le semoir (102) est destiné à planter quatre rangées et comprend quatre dispositifs de manutention des assemblages de sachet de semences et quatre dispositifs de dosage des semences respectifs, et dans lequel chaque dispositif de manutention des assemblages de sachet de semences (104) est destiné à libérer au moins une partie d'un échantillon de semences respectif dans un dispositif de dosage des semences respectifs, ou (c) dans lequel le semoir (102) est destiné à planter huit rangées et comprend quatre dispositifs de manutention des assemblages de sachets de semences, quatre dispositifs de séparation des échantillons de semences, et huit dispositifs de dosage des semences (108), et dans lequel chaque dispositif de manutention des assemblages de sachet de semences (104) est destiné à libérer au moins une partie d'un échantillon de semences respectif dans une paire respective des huit dispositifs de dosage des semences (108) par l'intermédiaire d'un dispositif de séparation des semences respectif

6. Système selon la revendication 2, dans lequel le dispositif de manutention des assemblages de sachet de semences (104) est destiné à ouvrir un assemblage de sachet de semence (200), comprenant des première et deuxième parties qui coopèrent pour contenir l'échantillon des semences de recherche, et dans lequel le dispositif de manutention des assemblages des sachets de semences est destiné à appliquer une force à l'assemblage de sachet de semences (200), de sorte que les première et deuxième parties de l'assemblage de sachet de semences

sont séparées au moins en partie, libérant ainsi l'échantillon de semences de recherche.

7. Système selon la revendication 1, dans lequel le dispositif de commande est destiné à contrôler le dispositif de manutention des assemblages de sachet de semences pour dériver la libération de l'échantillon de semences de recherche de l'assemblage de sachet de semences (200).

8. Système de plantation de semences de recherche automatisé selon la revendication 6, dans lequel la force comprend au moins une force de compression et dans lequel la force de compression entraîne le fléchissement vers l'extérieur d'au moins une des première et deuxième parties, par rapport à l'autre partie, autour d'un axe de flexion, de sorte que les première et deuxième parties sont au moins en partie se séparent en réponse à la force, libérant ainsi l'échantillon de semences de recherche, dans lequel le dispositif de manutention des assemblages de sachet de semences comprend de préférence en outre un outil d'ouverture et un outil de dégagement, et dans lequel le dispositif de commande est en outre destiné à entraîner l'outil d'ouverture à contacter l'assemblage de sachet de semences entre les première et deuxième parties de l'assemblage de sachet de semences et à contrôler automatiquement le dispositif de manutention des assemblages de sachet de semences afin d'appliquer une deuxième force à l'assemblage de sachet par l'intermédiaire de l'outil de dégagement, pour faciliter le fléchissement vers l'extérieur d'au moins une des première ou deuxième parties, par rapport à l'autre partie, autour de l'axe de flexion, de sorte que les première et deuxième parties sont séparées.

9. Système selon la revendication 1, dans lequel le dispositif de manutention des assemblages de sachet de semences (104) est destiné à être contrôlé sur la base d'un ou de plusieurs ensembles d'instructions, dans lequel l'un ou les plusieurs ensembles d'instructions sont de préférence dérivés d'un ou de plusieurs plans de recherche, au moins un des plans de recherche ou des ensembles d'instructions étant optionnellement stocké dans au moins un magasin de données (119).

10. Système de plantation de semences de recherche automatisé (100) selon la revendication 6, dans lequel (a) le dispositif de manutention des assemblages de sachet de semences (104) comprend en outre un outil d'ouverture (136), destiné à contacter l'assemblage de sachet de semences (200) entre les première et deuxième parties, et dans lequel la force comprend une force exercée par l'outil d'ouverture (136) sur l'assemblage de sachet de semences (200), ou (b) dans lequel la force comprend au moins une force de compression, et dans lequel la force de compression entraîne le fléchissement vers l'extérieur d'au moins une des première ou deuxième parties de l'assemblage de sachet de semences (200), par rapport à l'autre partie, autour d'un axe de flexion, de sorte que les première et deuxième parties sont au moins en partie séparées en réponse à la force, libérant ainsi l'échantillon de semences de recherche, dans lequel le dispositif de manutention des assemblages de sachet de semences (104) comprend de préférence en outre un outil d'ouverture (136) et un outil de dégagement (133), et dans lequel l'outil d'ouverture (136) est destiné à contacter l'assemblage de sachet de semences (200) entre les première et deuxième parties de l'assemblage de sachet de semences (200), de sorte à appliquer une deuxième force à l'assemblage de sachet de semences (200), et dans lequel la force de compression ainsi que les deuxième et troisième forces facilitent le fléchissement vers l'extérieur d'au moins une des première ou deuxième parties, par rapport à l'autre partie, autour de l'axe de flexion, de sorte que les première et deuxième parties sont séparées, ou (c) comprenant en outre un dispositif d'acquisition de données de position (115), destiné à acquérir des données de position, et dans lequel le dispositif de manutention des assemblages de sachet de semences (104) est destiné à fonctionner sur la base des données de position et d'un ou de plusieurs ensembles d'instructions, ou comprenant en outre un dispositif de séparation de l'échantillon de semences, destiné à recevoir l'échantillon de semences de recherche du dispositif de manutention des assemblages de sachet de semences (104).

11. Système selon la revendication 3, comprenant en outre un dispositif de détection de l'assemblage de sachet de semences (112), destiné à lire une étiquette (201) de l'assemblage de sachet de semences (200), dans lequel le dispositif de détection de l'assemblage de sachet de semences (112) comprend de préférence un dispositif sélectionné dans le groupe constitué de :

un lecteur de code à barres ;
un lecteur de caractères optiques ;
un lecteur d'identification par radiofréquence ; et
des combinaisons de ces dispositifs ; ou
comprenant en outre un dispositif d'acquisition de données de position (115) concernant une position de l'échantillon de semences de recherche libéré.

12. Système selon la revendication 1, comprenant en outre un dispositif de dosage des semences (108), destiné à recevoir l'échantillon de semences de recherche du dispositif de manutention des assemblages de sachet de semences (104), et dans lequel le

dispositif de dosage des semences (108) est destiné à séparer des semences individuelles de l'échantillon de semences de recherche et à libérer les semences individuelles dans la parcelle de recherche, et comprenant de préférence en outre un dispositif de détection du dosage des semences (113), destiné à détecter des semences individuelles lors de la libération des semences individuelles dans la parcelle de recherche.

13. Procédé de plantation d'une parcelle de recherche, ledit procédé comprenant les étapes ci-dessous :

transport d'un semoir (102), comprenant un dispositif de manutention des assemblages de sachet de semences (104), comprenant un assemblage de plateau de semences (105) retenant plusieurs assemblages de sachet de semences (200), chaque assemblage de sachet de semences contenant un échantillon de semences ;
déplacement d'un assemblage de plateau de semences (105) pour aligner l'assemblage de sachet de semences (200) avec une surface de chargement (124) ; et
contrôle du dispositif de manutention des assemblages de sachet de semences (104) par l'intermédiaire d'un dispositif de commande (103), pour libérer automatiquement l'échantillon de semences de recherche.

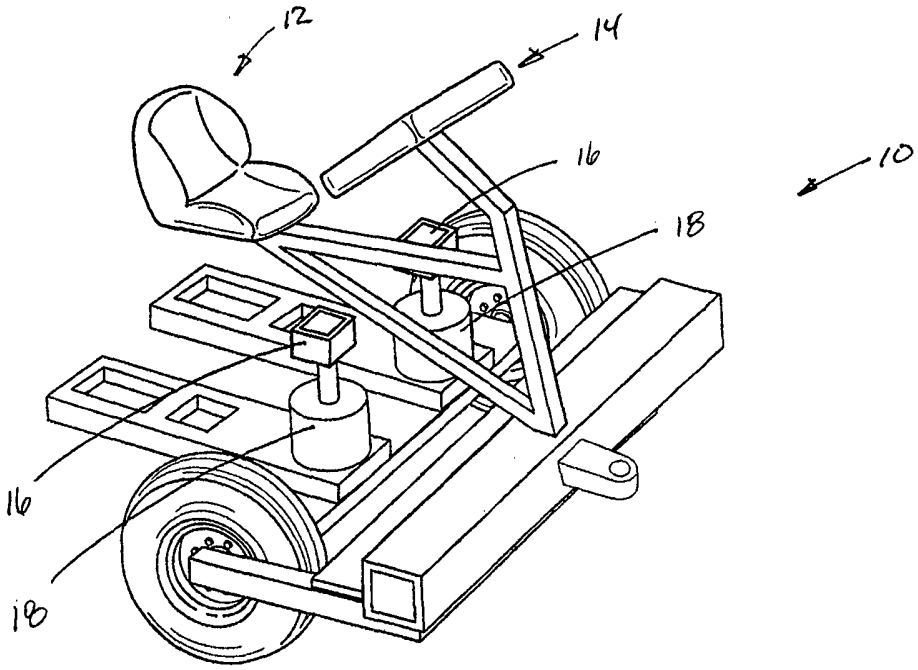


FIG. 1
(PRIOR ART)

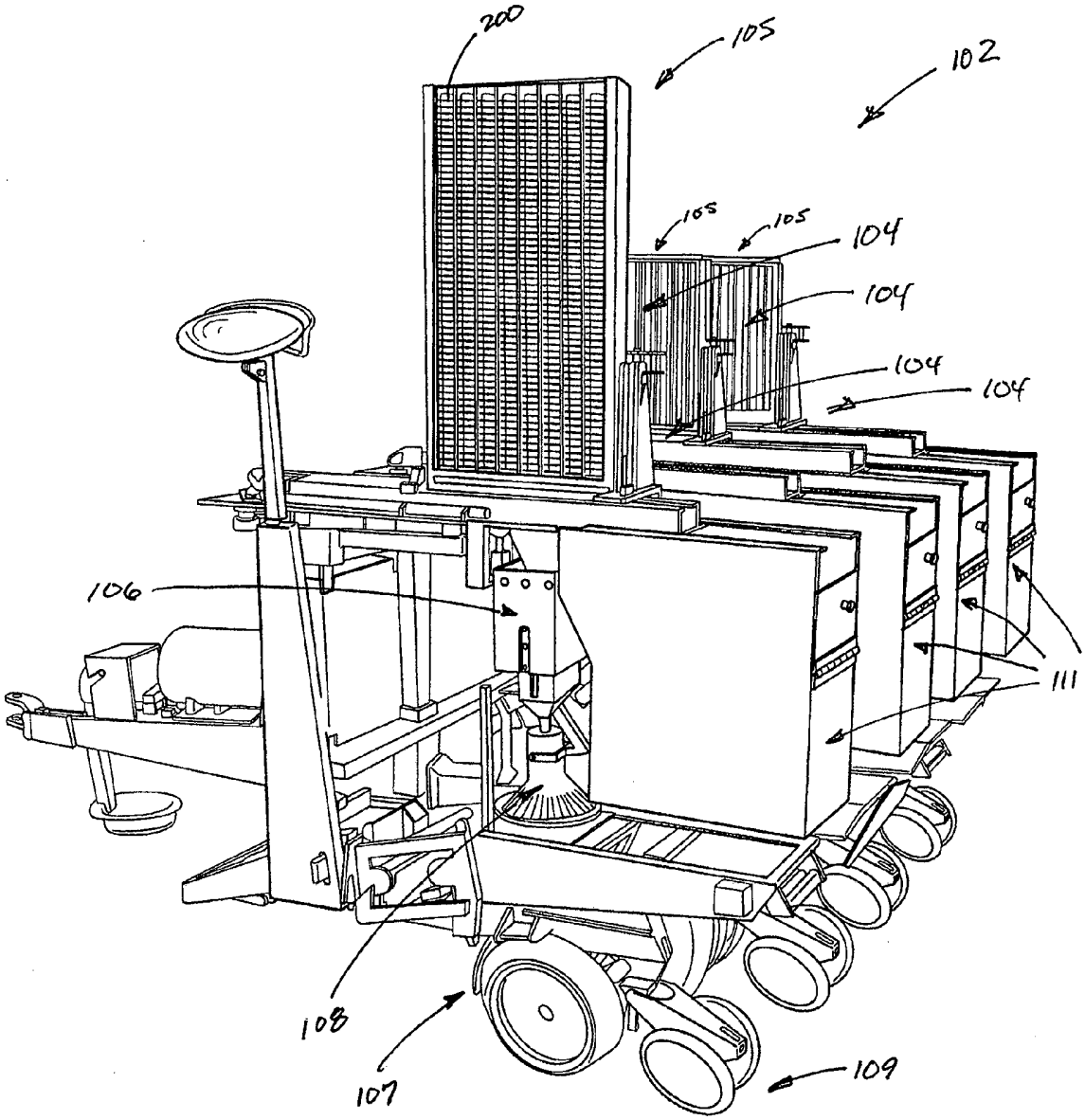


FIG. 2

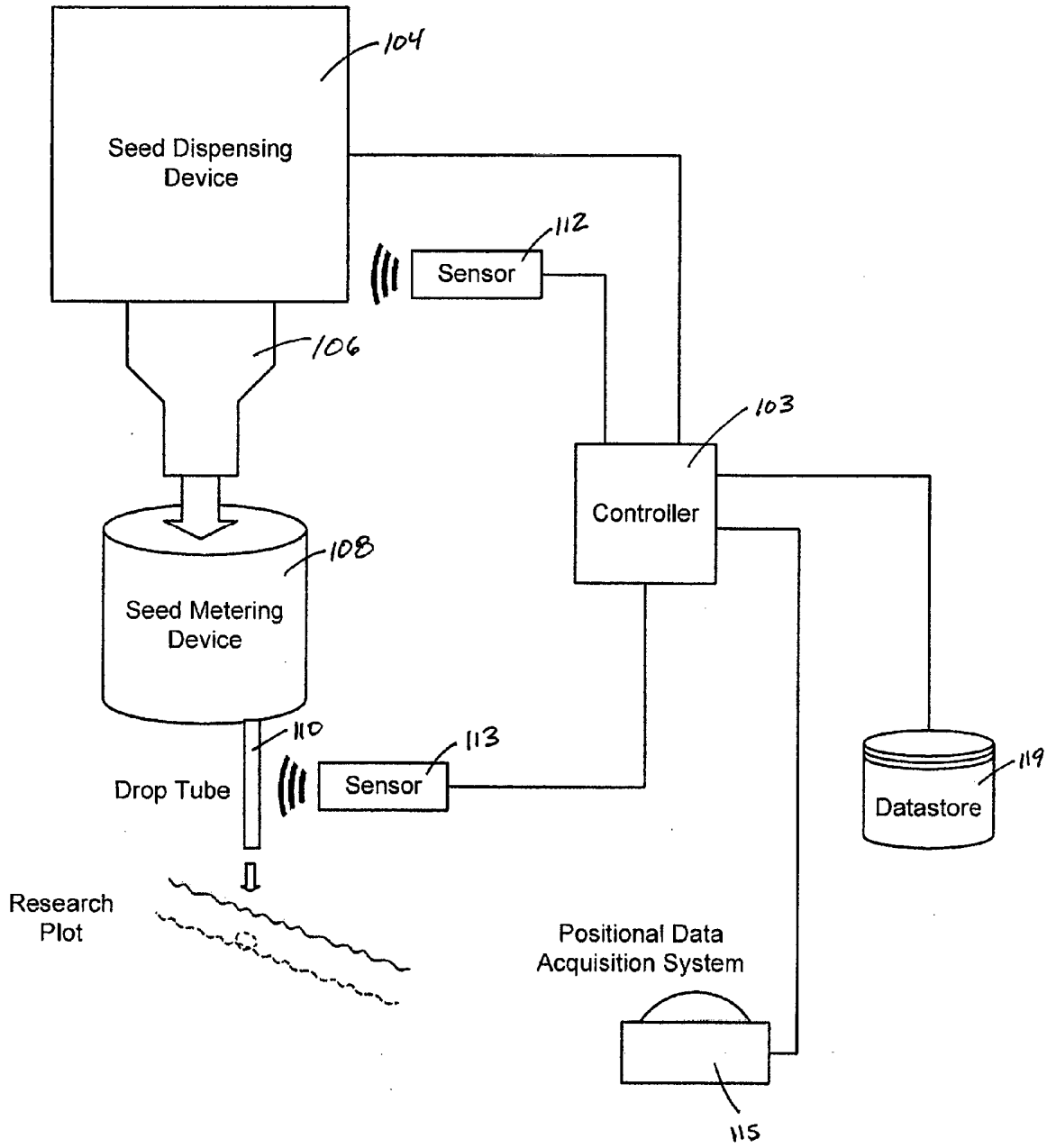

104
Seed Dispensing Device
112
Sensor
106
103
Controller
108
Seed Metering Device
110
Drop Tube
113
Sensor
119
Datastore
Research Plot
Positional Data Acquisition System
115

FIG. 3

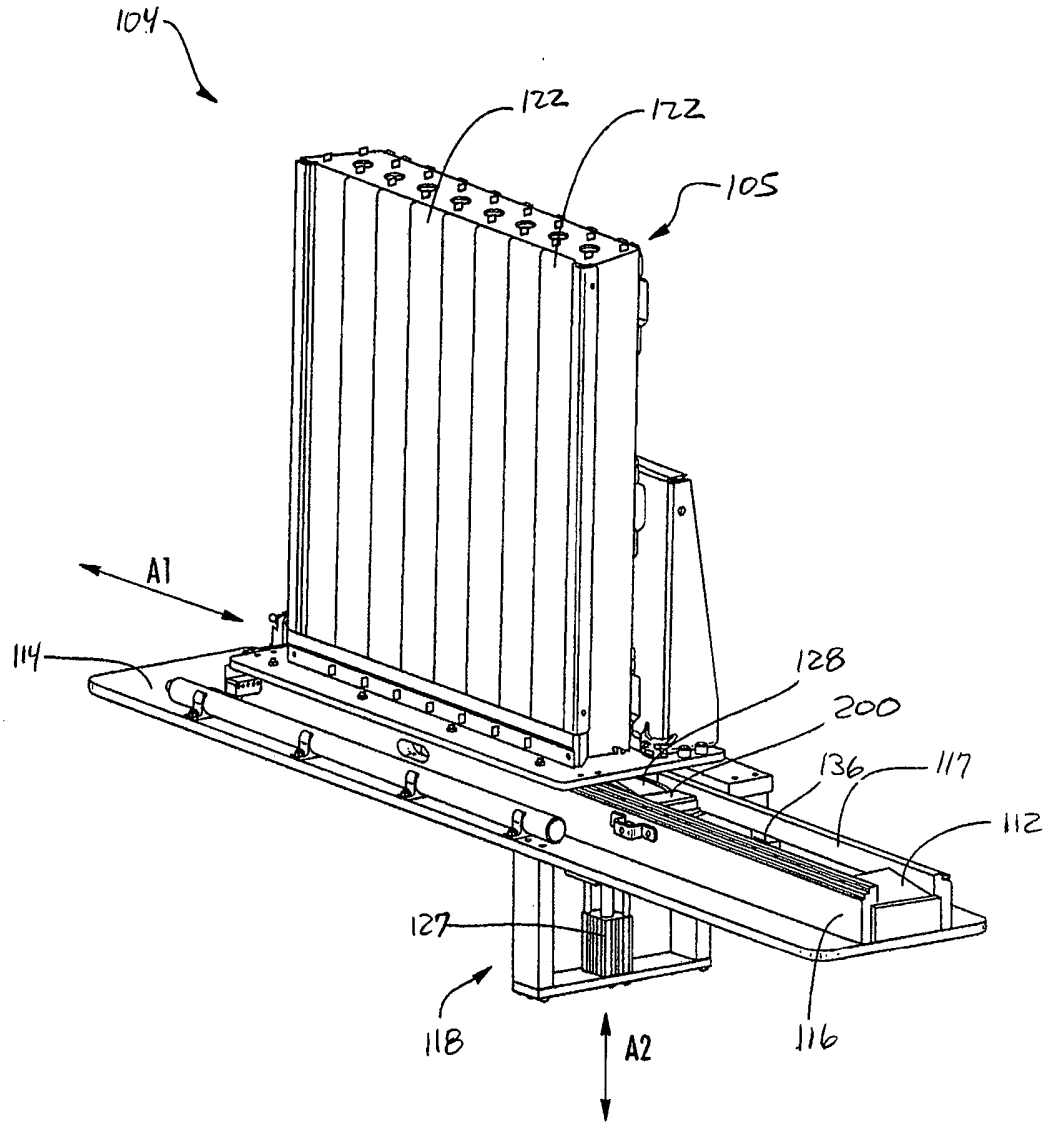
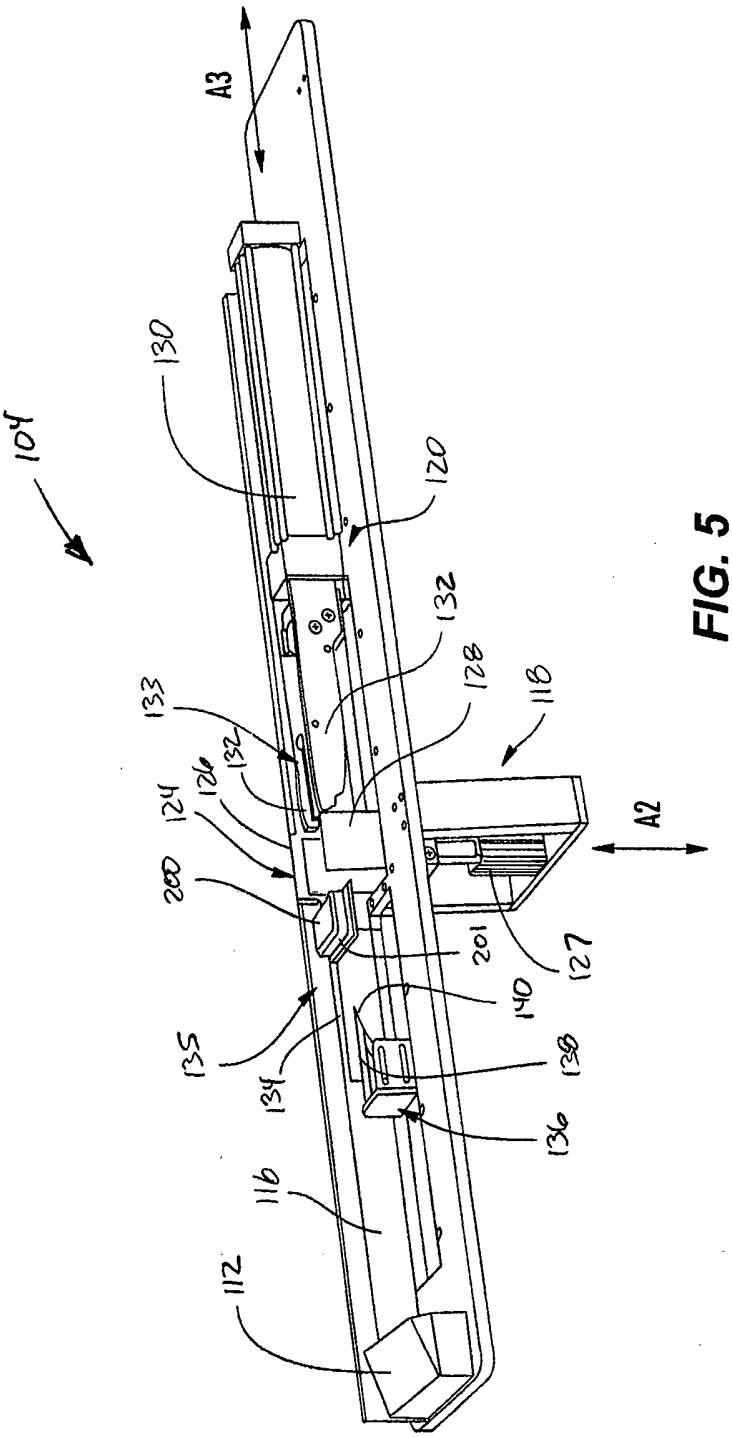


FIG. 4


104
A3
130
120
132
128
116
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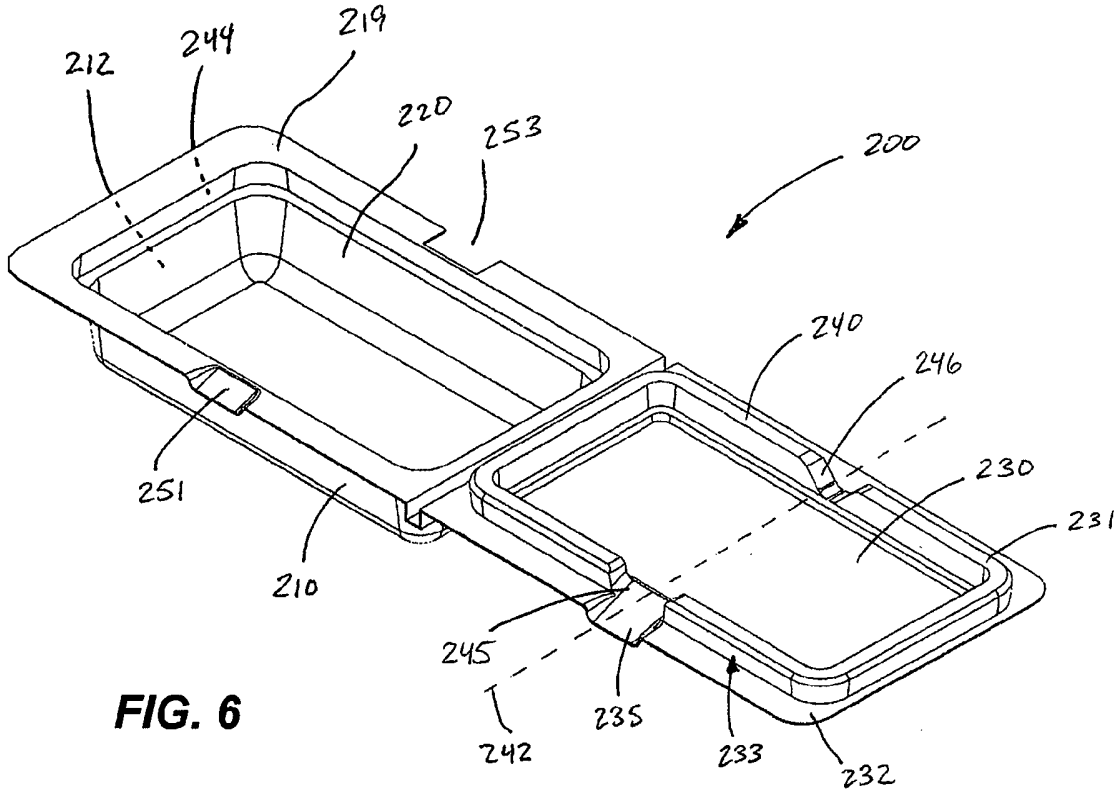
132
126
124
200
201
127
140
135
134
138
136
116
112
A2

FIG. 5


212
244
219
220
253
200
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246
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231
251
210
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242
235
233
232

FIG. 6

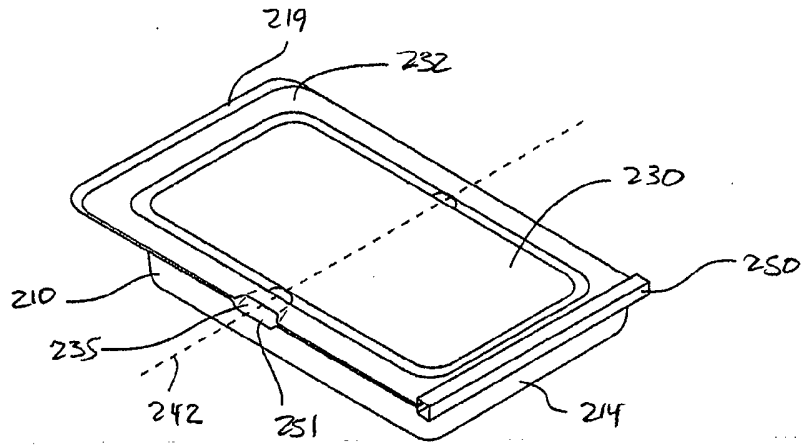

219
232
230
250
210
235
242
251
214

FIG. 6A

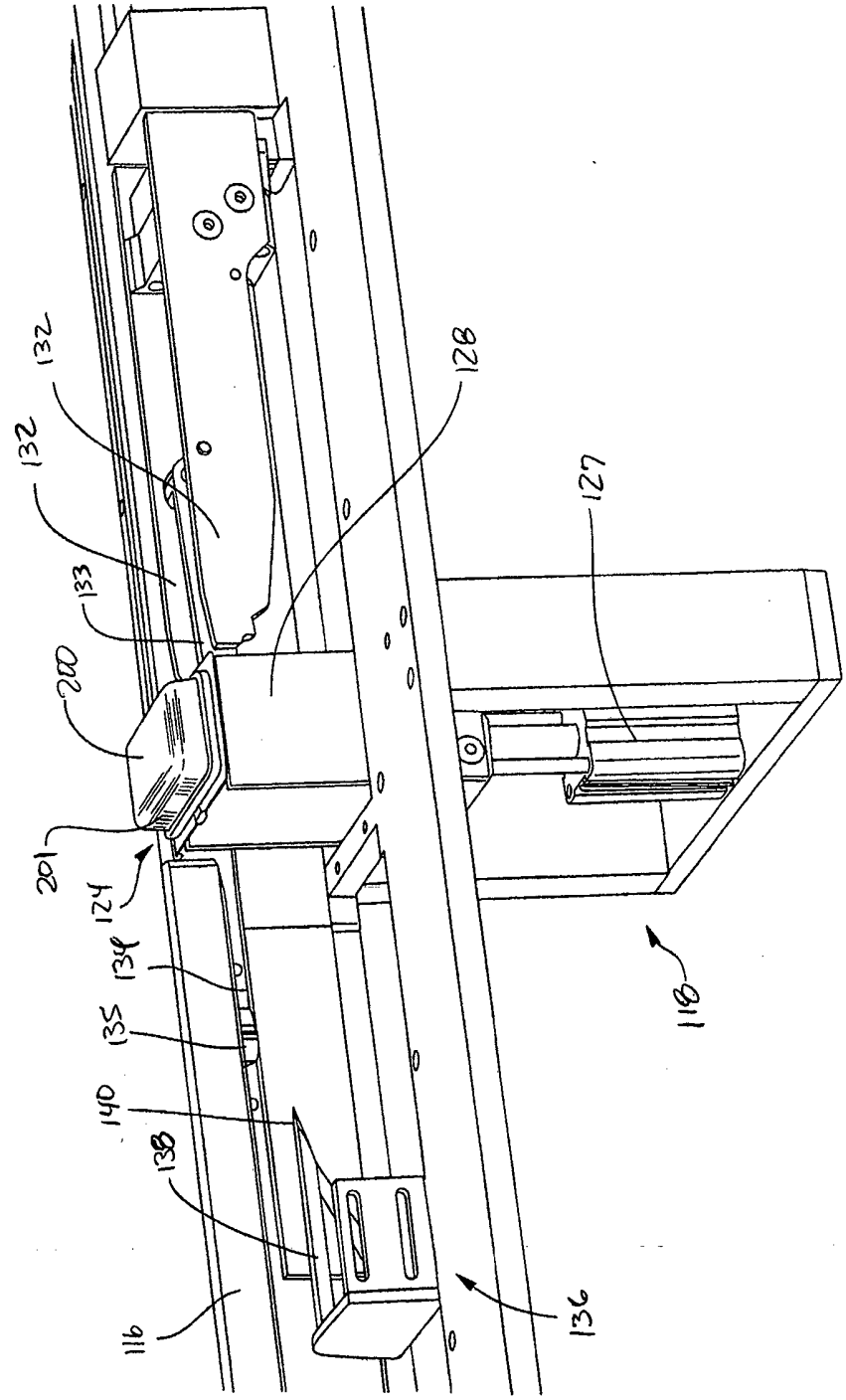


FIG. 7

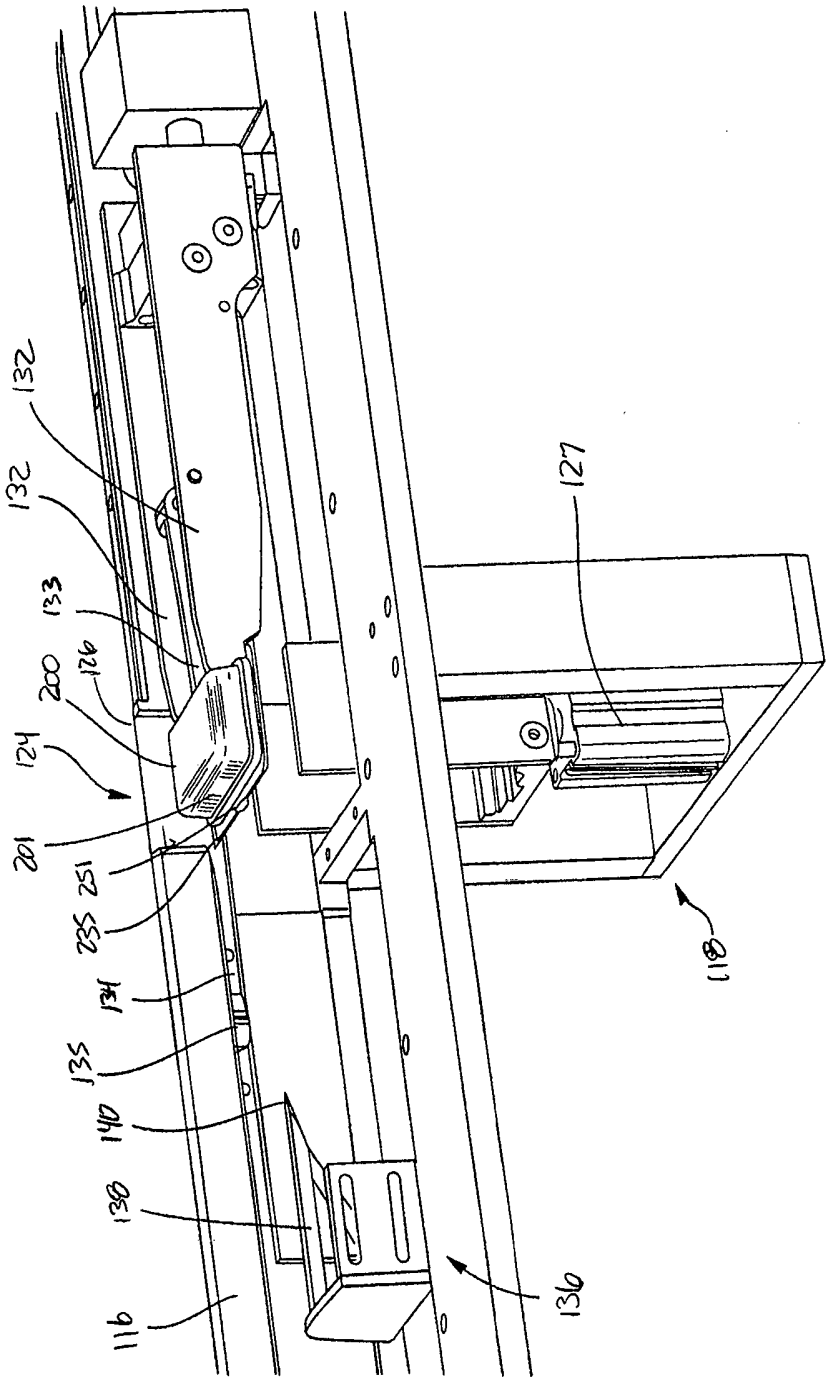

132
132
133
126
200
124
201
251
235
134
135
140
138
116
136
127
118

FIG. 8

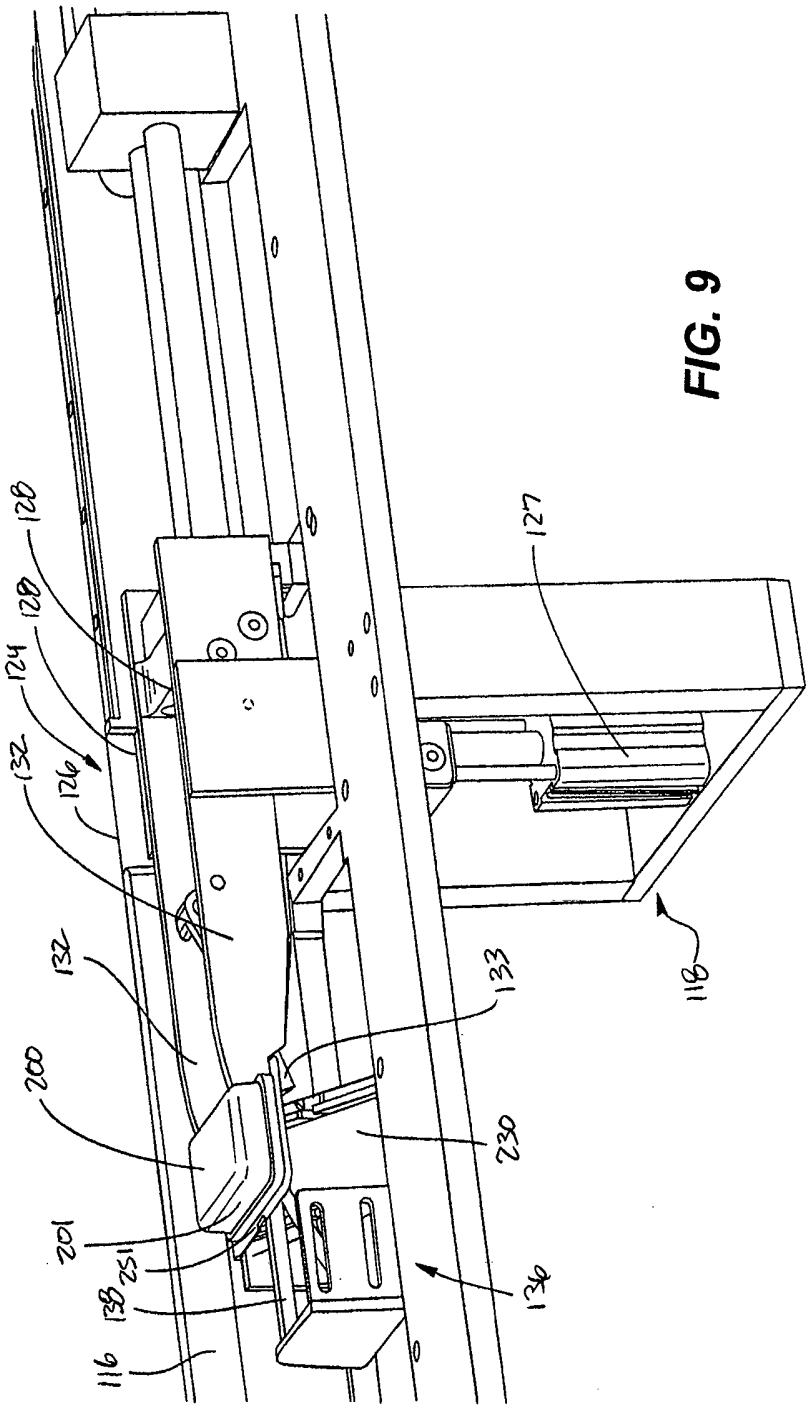


FIG. 9

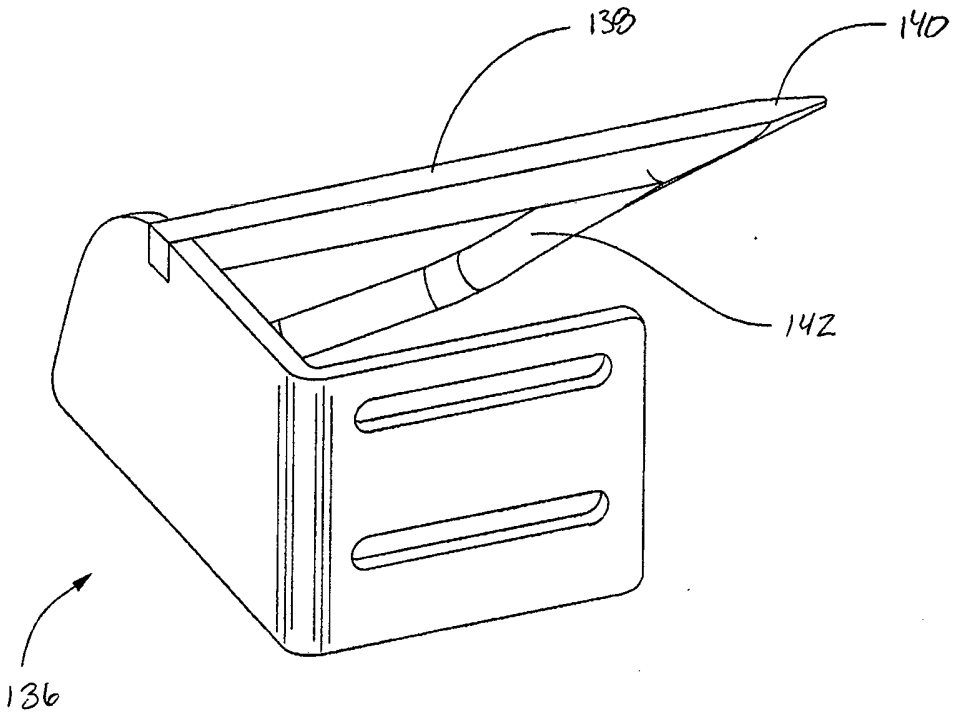
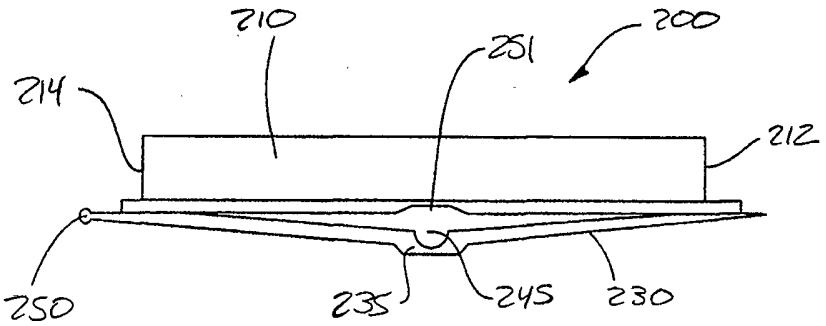


FIG. 10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251
200
214
212
250
235
245
230

FIG. 11

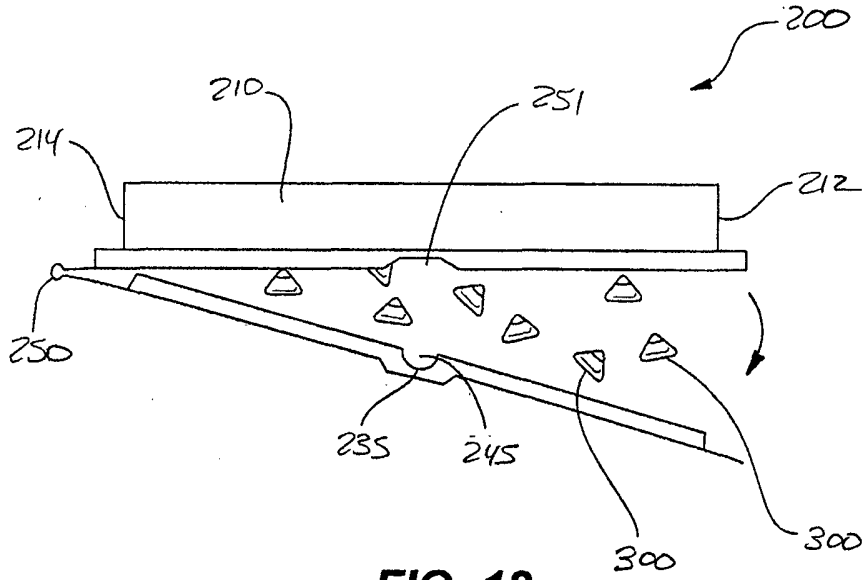
200
210
251
214
212
250
235
245
300
300

FIG. 12

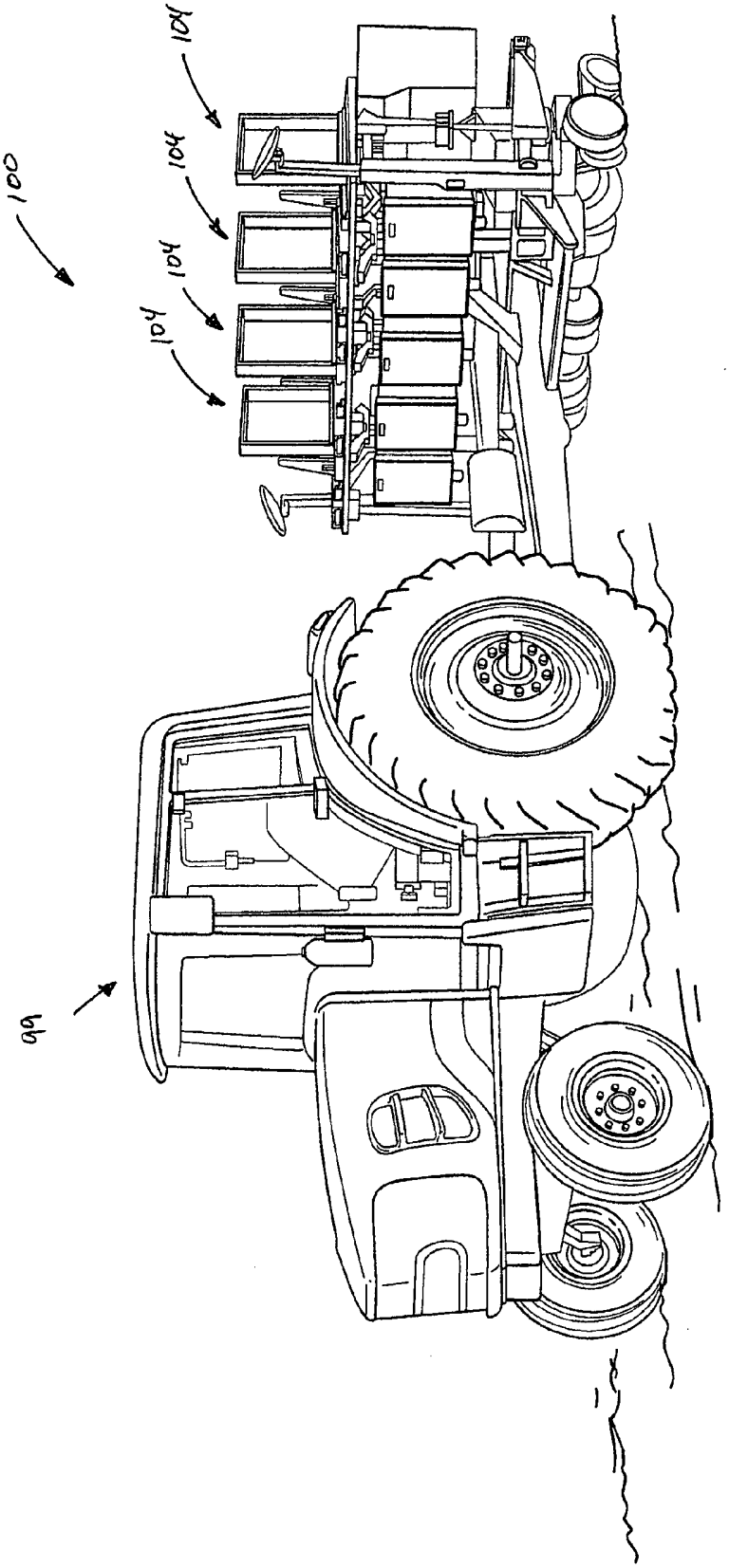

FIG. 13

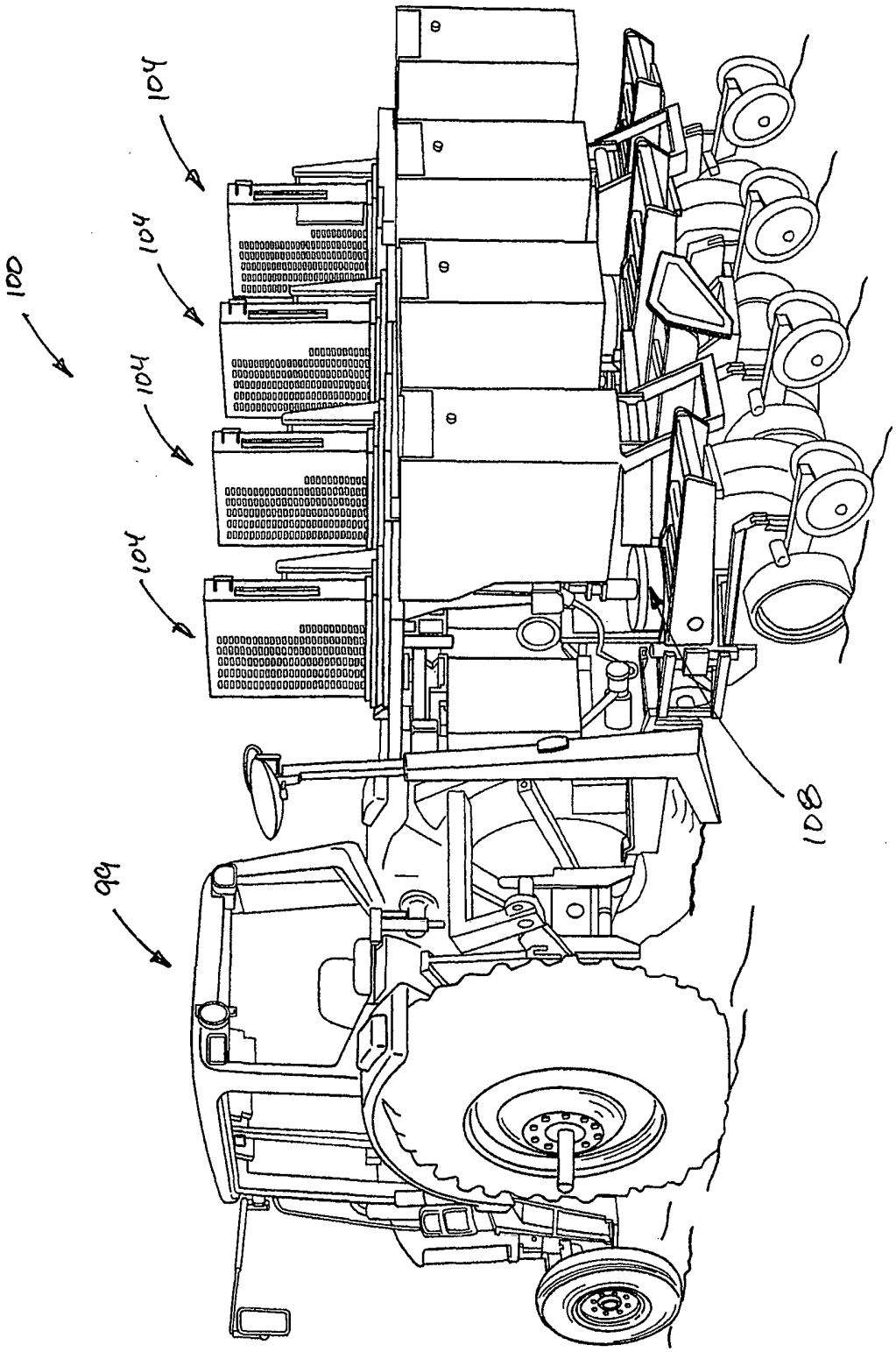

FIG. 14

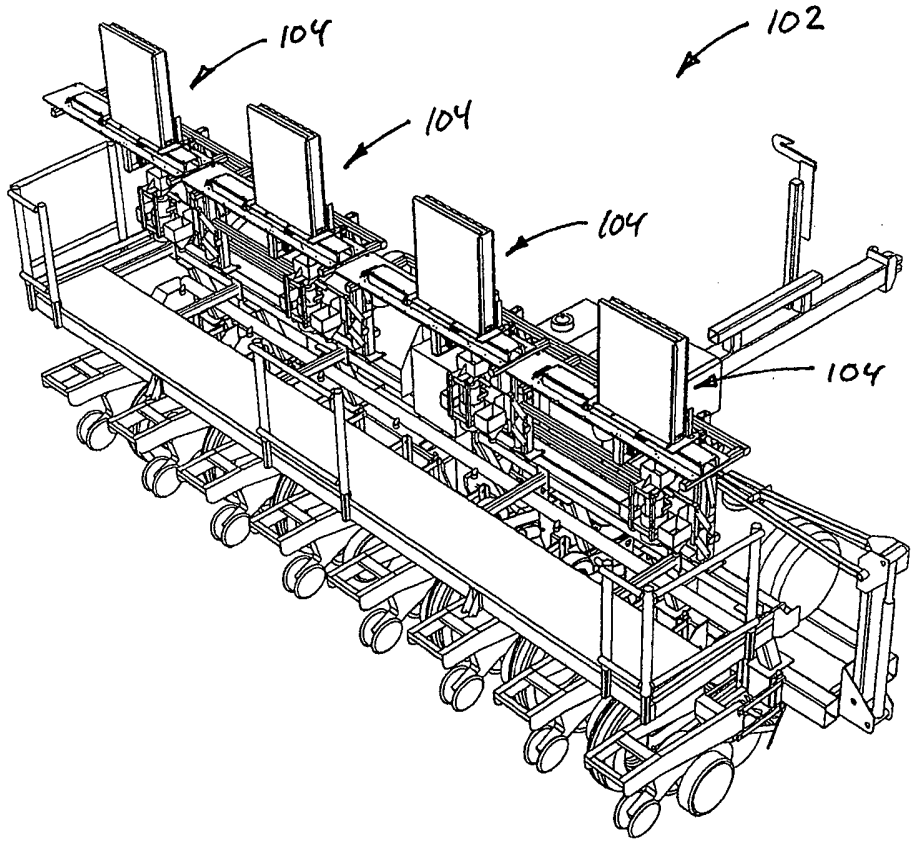

FIG. 15

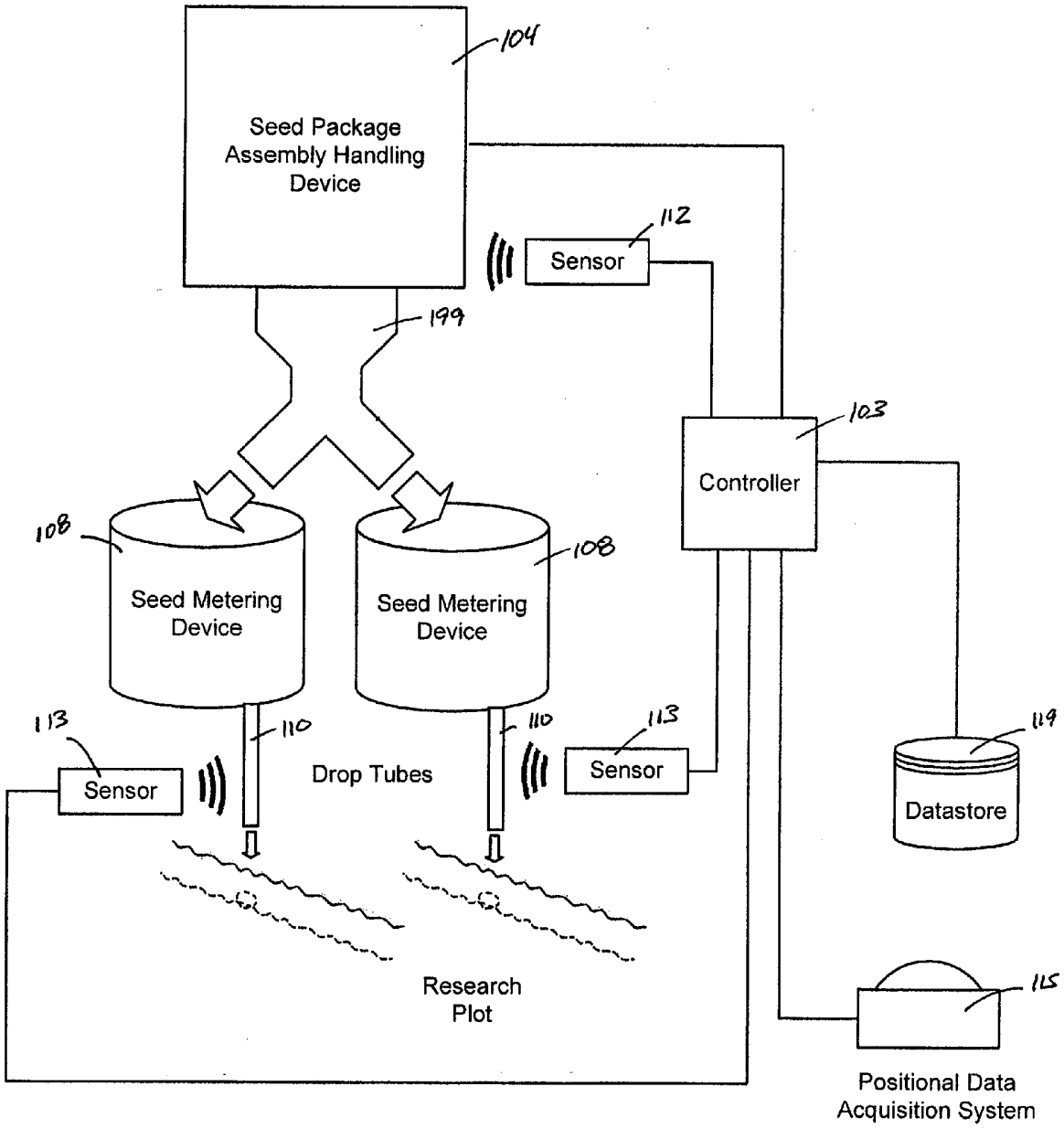
104
Seed Package Assembly Handling Device
112
Sensor
199
103
Controller
108
Seed Metering Device
108
Seed Metering Device
113
Sensor
110
110
Drop Tubes
113
Sensor
119
Datastore
Research Plot
115
Positional Data Acquisition System

FIG. 16

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- US 20010000806 A1 **[0004]**
- US 20090010750 A **[0025]**
- US 20080006627 A **[0025]**

SZABADALMI IGÉNYPONTOK

1. Automatizált kutatási ültetési rendszer (100), ahol egy rendszer tartalmaz:

ültetőgépet (102), amely egy kutatási parcella beültetésére van kialakítva és tartalmaz egy magcsomag elrendezés kezelő berendezést (104), amely tartalmaz egy magtekno elrendezést (105), amely úgy van kialakítva, hogy tartson több magcsomag elrendezést (200), mindegyik magcsomag elrendezés tartalmaz egy kutatási mag mintát; és

vezérlőt (103), amely kommunikációra van kialakítva a magcsomag elrendezés kezelő berendezéssel (104),

ahol a vezérlő (103) úgy van kialakítva, hogy vezérelje a magcsomag elrendezés kezelő berendezést (104), hogy automatikusan leadja a kutatási magmintát a magcsomag elrendezésből (200).

2. Az 1. igénypont szerinti automatizált kutatási magültető rendszer (100), ahol a vezérlő (103) továbbá úgy van kialakítva, hogy automatikusan vezérelje a magcsomag kezelő berendezést (104), hogy erőt fújtasson ki a magcsomag elrendezésre, hogy leadja a kutatási magmintát a magcsomag elrendezésből (200).

3. Az 1. igénypont szerinti automatizált kutatási magültető rendszer (100), ahol a magcsomag elrendezés (200) tartalmaz legalább egy gépileg olvasható vagy ember számára olvasható címkét (201).

4. Az 1. igénypont szerinti automatizált kutatási magültető rendszer (100), amely továbbá tartalmaz egy pozícióadat gyűjtőberendezést (115), amely úgy van kialakítva, hogy gyűjtsön pozícióadatokat és ahol a vezérlő (103) úgy van kialakítva, hogy vezérelje a magcsomag elrendezés kezelő berendezést (104) a pozícióadatok és egy vagy több utasításkészlet szerint, előnyösen ahol egy vagy több utasításkészlet egy vagy több kutatási tervből van leszármaztatva, előnyösebben a kutatási terv vagy az utasításkészlet legalább egyike tárolva van legalább egy adatárban.

5. Az 1. igénypont szerinti automatizált kutatási magültető rendszer (100), ahol az ültetőgép (102) tartalmaz több magcsomag elrendezés kezelő berendezést (104), ahol mindegyik úgy van kialakítva, hogy befogadja több magcsomag elrendezés (200) vonatkozó magcsomag elrendezését, és ahol egy vagy több vezérlő (103) úgy van kialakítva, hogy automatikusan vezérelje mindegyik magcsomag elrendezés kezelő berendezést, hogy leadjon egy vonatkozó kutatási magmintát a kutatási parcellába, előnyösen vagy (a) ahol az ültetőgép (102) továbbá tartalmaz egy több magmérő berendezést (108), ahol mindegyik úgy van kialakítva, hogy befogadjon egy vonatkozó kutatási magmintát egy vonatkozó magcsomag elrendezés kezelő berendezésből (104), és ahol mindegyik mag mérő berendezés (108) továbbá úgy van kialakítva, hogy elkülönítsen egyes magokat a vonatkozó kutatási magmintából és leadja az egyes magokat a kutatási parcellába, előnyösen továbbá tartalmaz több magmérő szenzor berendezést (113), amely úgy van kialakítva, hogy érzékeljen egyes magokat, ahogy az egyes magok le vannak adva a kutatási parcellába, vagy (b) ahol az ültetőgép (102) úgy van kialakítva, hogy ültessen négy sort és tartalmaz négy magcsomag elrendezés kezelő berendezést és négy vonatkozó magmérő berendezést, és ahol mindegyik magcsomag elrendezés kezelő berendezés (104) úgy van kialakítva, hogy leadja egy vonatkozó magminta legalább egy részét egy vonatkozó magmérő berendezésbe, vagy (c) ahol az ültetőgép (102) úgy van kialakítva, hogy ültet nyolc sort és tartalmaz négy magcsomag elrendezés kezelő berendezést, négy magminta felosztó berendezést, és nyolc mag mérő berendezést (108), és ahol mindegyik magcsomag elrendezés kezelő

berendezés (104) úgy van kialakítva, hogy leadja egy vonatkozó magminta legalább egy részét nyolc magmérő berendezést (104) egy vonatkozó párjába egy vonatkozó magminta felosztó berendezés útján.

6. A 2. igénypont szerinti rendszer, ahol a magcsomag elrendezés kezelő berendezés (104) úgy van kialakítva, hogy nyissa egy magcsomag elrendezést (200), amely tartalmaz első és második részeket, amelyek együttműködnek, hogy tartalmazzák az kutatási mag mintát, és ahol a magcsomag elrendezés kezelő berendezés úgy van kialakítva, hogy erőt alkalmazzon a magcsomag elrendezésre (200), úgy hogy a magcsomag elrendezés első és második részei legalább részben elkülönüljenek, így kibocsátva a kutatási magmintát.

7. Az 1. igénypont szerinti rendszer, ahol a vezérlő úgy van kialakítva, hogy vezérelje a magcsomag elrendezés kezelő berendezést, hogy megkerülje a kutatási magminta kibocsátását a magcsomag elrendezésből (200).

8. A 6. igénypont szerinti automatizált kutatási magülletö rendszer, ahol az erő tartalmaz legalább egy nyomóerőt és ahol a nyomóerő magcsomag elrendezés első vagy második részének legalább egyikét kifelé hajlítja a másik résztől egy hajlítási tengely körül, úgy hogy az első és második részek legalább részlegesen elkülönülnek az erőre adott válaszként, így leadva a kutatási mag mintát, előnyösen ahol a magcsomag elrendezés kezelő berendezés továbbá tartalmaz egy nyitó szerszámot és egy szétkapcsoló szerszámot, és ahol a vezérlő továbbá úgy van kialakítva, hogy a nyitó szerszám érintkezést hozzon létre a magcsomag elrendezés első és második része közötti és automatikusan vezérelje a magcsomag elrendezés kezelő berendezést, hogy egy második erőt fejtsen ki a csomag elrendezésre a szétkapcsoló szerszám útján, hogy az első vagy második részek legalább egyike támogatva van abban, hogy kifelé hajoljon a másik résztől a hajlítási tengely körül, úgy hogy az első és második részek elkülönülnek.

9. Az 1. igénypont szerinti rendszer, ahol a magcsomag elrendezés kezelő berendezés (104) úgy van kialakítva, hogy vezérelve legyen egy vagy több utasításkészlet szerint, előnyösen ahol az egy vagy több utasításkészlet származtatva van egy vagy több kutatási tervből és opcionálisan a kutatási terv vagy az utasításkészlet legalább egyike legalább egy adattárban (119) van.

10. A 6. igénypont szerinti automatizált kutatási magülletö rendszer (100), ahol vagy (a) a magcsomag elrendezés kezelő berendezés (104) továbbá tartalmaz egy nyitó szerszámot (136), amely úgy van kialakítva, hogy érintkezésbe hozza a magcsomag elrendezést (200) az első és második részek között és ahol az erő tartalmaz egy erőt, amelyet a nyitó szerszám (136) fejt ki a magcsomag elrendezésen (200), vagy (b) ahol az erő tartalmaz legalább egy nyomóerőt és ahol a nyomóerő a magcsomag elrendezés (200) első és második részének legalább egyike kifelé hajlítja a másik résztől egy hajlítási tengely körül, úgy hogy az első és második részek legalább részlegesen elkülönülnek az erőre adott válaszként, így leadva az kutatási magmintát, előnyösen ahol a magcsomag elrendezés kezelő berendezés (104) továbbá tartalmaz nyitó szerszámot (136) és egy szétkapcsoló szerszámot (133), és ahol a nyitó szerszám (136) úgy van kialakítva, hogy érintkezésbe hozza a magcsomag elrendezést (200) a magcsomag elrendezés (200) első és második része között, úgy hogy második erőt alkalmaz a magcsomag elrendezésre (200) és a szétkapcsoló szerszám (136) úgy van kialakítva, hogy egy harmadik erőt alkalmaz a magcsomag elrendezésre (200), és ahol a nyomóerő és a második és harmadik erők támogatják az első vagy második részek legalább egyikét, hogy kifelé hajoljon a másik résztől a hajlítási tengely körül, úgy hogy az első és második részek elkülönüljenek, vagy (c) továbbá tartalmaz egy pozícióadatgyűjtőberendezést (115), amely úgy van

kialakítva, hogy gyűjtsön pozícióadatokat és ahol a magcsomag elrendezés kezelő berendezés (104) úgy van kialakítva, hogy a pozícióadatok és egy vagy több utasításkészlet szerint működjön, vagy továbbá tartalmaz egy magminta felosztó berendezést, amely úgy van kialakítva, hogy befogadja a kutatási magmintát a magcsomag elrendezés kezelő berendezésből (104).

11. A 3. igénypont szerinti rendszer, amely továbbá tartalmazza egy magcsomag elrendezés szenzor berendezést (112), amely a magcsomag elrendezés (200) egy címkéjének (201) olvasására van kialakítva, előnyösen, ahol a magcsomag elrendezés szenzor berendezés (112) tartalmaz egy berendezést, amely ki van választva a következőkből álló csoportból:

vonalkód olvasó;

OCR olvasó;

RFID olvasó; és

ezek kombinációi, vagy

továbbá tartalmaz egy pozícióadatgyűjtőberendezést (115), amely úgy van kialakítva, hogy pozícióadatokat gyűjtsön, amelyek a leadott kutatási mag minta pozíciójára vonatkoznak.

12. Az 1. igénypont szerinti rendszer, amely továbbá tartalmaz egy magmérő berendezést (108), amely úgy van kialakítva, hogy befogadja a kutatási magmintát a magcsomag elrendezés kezelő berendezésből (104), és ahol a magmérő berendezés (108) úgy van kialakítva, hogy elkülönítsen egyes magokat a kutatási magmintából és leadja az egyes magokat a kutatási parcellába, előnyösen továbbá tartalmaz egy magmérő szenzor berendezést (113), amely úgy van kialakítva, hogy érzékel egyes magokat, ahogy az egyes magok le vannak adva a kutatási parcellába.

13. Eljárás kutatási parcella ültetésére, ahol az eljárás tartalmazza:

ültetőgép (102) szállítását, amely tartalmaz egy magcsomag elrendezés kezelő berendezést (104), amely tartalmaz egy mag tekercs elrendezést (105), amely tart több magcsomag elrendezést (200), ahol mindegyik magcsomag elrendezés tartalmaz egy kutatási magmintát;

magtekercs elrendezés (105) mozgatását, hogy vonalba hozzuk az magcsomag elrendezést (200) egy ültetési területtel (124); és

a magcsomag elrendezés kezelő berendezés (104) vezérlését, vezérlő (103) használatával, hogy automatikusan leadjuk a kutatási mag mintát.