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(54) **Title:** ROW CLEANER PRESCRIPTION METHOD

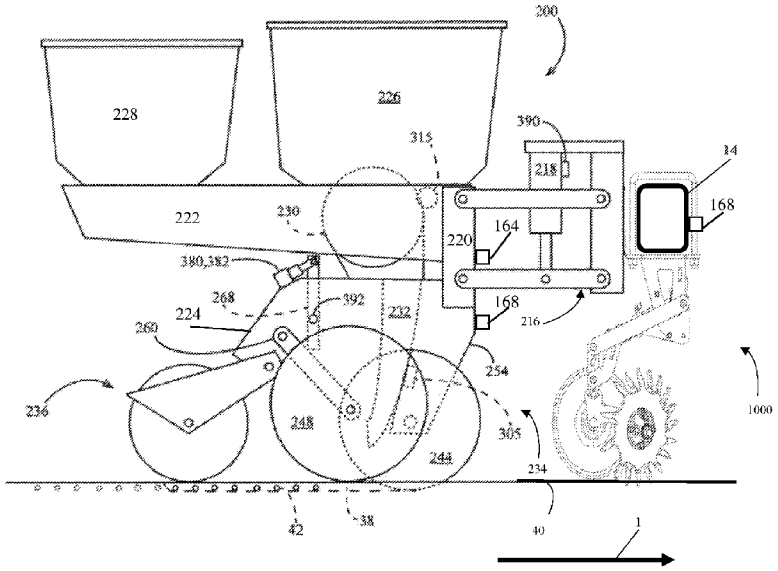

FIG. 2A

(57) **Abstract:** A method of controlling a row cleaner (200) according to a prescription as the row cleaner traverses a field.

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ROW CLEANER PRESCRIPTION METHOD

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Application No. 63/150428, filed 17 February 2021, the contents of which is incorporated herein by reference in its entirety.

BACKGROUND

[0002] Agricultural fields can vary by soil type, wetness, elevations, and other factors across an entire field. How one part of a field is treated is not necessarily the same way another part of the field would be treated. It would be helpful to adjust field treatments according to local conditions in a field.

BRIEF DESCRIPTION OF THE DRAWINGS

[0003] FIG. 1 is a top view of an embodiment agricultural planter.

[0004] FIG. 2A is a side elevation view of an embodiment of a planter row unit.

[0005] FIG. 2B is a side elevation view of a tractor and planter with the row unit of FIG. 2A and other components of the monitor system of FIG. 3.

[0006] FIG. 3 schematically illustrates an embodiment of a monitor system and data transmission between components of the monitor system.

[0007] FIG. 4 illustrates an embodiment of a process for setting up a monitor system, controlling an implement, and storing and mapping operational data.

[0008] FIG. 5 illustrates a monitor displaying a prescription map.

DETAILED DESCRIPTION

[0009] All references cited herein are incorporated herein in their entireties. If there is a conflict between a definition herein and in an incorporated reference, the definition herein shall control.

[0010] Referring now to the drawings, wherein like reference numerals designate identical or corresponding parts throughout the several views, FIG. 1 illustrates a tractor 5 drawing an agricultural implement, e.g., a planter 10, comprising a toolbar 14 operatively supporting multiple row units 200. An implement monitor 110 preferably including a central processing unit ("CPU"), memory and graphical user interface ("GUI") (e.g., a touch-screen interface) is

preferably located in the cab of the tractor 10. A global positioning system ("GPS") receiver 166 is preferably mounted to the tractor 10. While described using a planter, the invention can be used with any agricultural implement that includes a row cleaner, such as a strip till implement.

[0011] Turing to FIG. 2A, an embodiment is illustrated in which the row unit 200 is a planter row unit. The row unit 200 is preferably pivotally connected to the toolbar 14 by a parallel linkage 216. An actuator 218 is preferably disposed to apply lift and/or downforce on the row unit 200. A solenoid valve 390 is preferably in fluid communication with the actuator 218 for modifying the lift and/or downforce applied by the actuator. An opening system 234 can include two opening discs 244 rollingly mounted to a downwardly-extending shank 254 and disposed to open a v-shaped trench 38 in the soil 40. A pair of gauge wheels 248 is pivotally supported by a pair of corresponding gauge wheel arms 260; the height of the gauge wheels 248 relative to the opener discs 244 sets the depth of the trench 38. A depth adjustment rocker 268 limits the upward travel of the gauge wheel arms 260 and thus the upward travel of the gauge wheels 248. A depth adjustment actuator 380 is preferably configured to modify a position of the depth adjustment rocker 268 and thus the height of the gauge wheels 248. The actuator 380 is preferably a linear actuator mounted to the row unit 200 and pivotally coupled to an upper end of the rocker 268. In some embodiments the depth adjustment actuator 380 comprises a device such as that disclosed in International Patent Application No. PCT/US2012/035585, the disclosure of which is hereby incorporated herein by reference. An encoder 382 is preferably configured to generate a signal related to the linear extension of the actuator 380; it should be appreciated that the linear extension of the actuator 380 is related to the depth of the trench 38 when the gauge wheel arms 260 are in contact with the rocker 268. A downforce sensor 392 is preferably configured to generate a signal related to the amount of force imposed by the gauge wheels 248 on the soil 40; in some embodiments the downforce sensor 392 comprises an instrumented pin about which the rocker 268 is pivotally coupled to the row unit 200, such as those instrumented pins disclosed in U.S. Patent Application Publication No. US2010/0180695.

[0012] Continuing to refer to FIG. 2A, a seed meter 230 such as that disclosed in Applicant's co-pending International Patent Application No. PCT/US2012/030192 is preferably disposed to deposit seeds 42 from a hopper 226 into the trench 38, e.g., through a seed tube 232 disposed to guide the seeds toward the trench. In some embodiments, the meter is powered by an electric drive 315 configured to drive a seed disc within the seed meter. In other embodiments, the drive

315 may comprise a hydraulic drive configured to drive the seed disc. A seed sensor 305 (e.g., an optical or electromagnetic seed sensor configured to generate a signal indicating passage of a seed) is preferably mounted to the seed tube 232 and disposed to send light or electromagnetic waves across the path of seeds 42. A closing system 236 including one or more closing wheels is pivotally coupled to the row unit 200 and configured to close the trench 38.

[0013] A row cleaner 1000 can be attached to toolbar 14 or to row unit 200. A nonlimiting example of a row cleaner 1000 is illustrated in FIG. 2A. Examples of a row cleaner are found in U.S. Patent No. 8,550,020 and U.S. Application Nos. 63/074,684, filed on 4 September 2020, and 63/040,311, filed 17 June 2020.

[0014] FIG. 3 illustrates an embodiment of a monitor system 100. An example of a monitor system is described in PCT Publication No. WO2014/026183. The monitor system 100 can include a monitor device 110, a communication module 120, and a display device 130. The monitor device 110 can include a graphical user interface (GUI) 112, memory 114, and a central processing unit (CPU) 116. The monitor device 110 is in electrical communication with the communication module 120 via a harness 150. The communication module 120 optionally, but not necessarily, includes an authentication chip 122 and memory 126. The communication module 120 is in electrical communication with the display device 130 via a harness 152. The display device 130 can include a GUI 132, memory 134, a CPU 136 and a wireless Internet connection means 154 for connecting to a "cloud" based storage server 140. One such wireless Internet connection means 154 may comprise a cellular modem 138. Alternatively, the wireless Internet connection means 154 may comprise a wireless adapter 139 for establishing an Internet connection via a wireless router.

[0015] The display device 130 may be a consumer computing device or other multi-function computing device. The display device 130 can include general purpose software including an Internet browser. The display device 130 also can include a motion sensor 137, such as a gyroscope or accelerometer, and can use a signal generated by the motion sensor 137 to determine a desired modification of the GUI 132. The display device 130 also can include a digital camera 135 whereby pictures taken with the camera 135 may be associated with a global positioning system (GPS) position, stored in the memory 134 and transferred to the cloud storage server 140. The display device 130 also can include a GPS receiver 131.

[0016] The monitor device 110 is preferably in electrical communication with seed sensors 305,

downforce sensors 392, ride quality sensors 164, a GPS receiver 166, and one or more speed sensors 168 via a harness 156. The monitor device 110 is preferably in electrical communication with clutches 170, drives 172, and downforce valves 390 via a harness 158.

[0017] Turning to FIGs. 2A and 2B, an embodiment of the monitor system 100 is illustrated integrated on a planter 10 drawn by a tractor 5. The planter 10 includes a transversely extending toolbar 14 to which multiple row units 200 are mounted.

[0018] Referring to FIG. 2A, each row unit 200 is supported from the toolbar 14 by a parallel linkage 216 which permits each row unit to move vertically independently of the toolbar and the other spaced row units in order to accommodate changes in terrain or upon the row unit encountering a rock or other obstruction as the planter is drawn through the field. The ride quality sensor 164, preferably an accelerometer, is mounted to the row unit 200 and disposed to measure the vertical velocity and acceleration of the row unit 200. Speed sensors 168, such as radar speed sensors or GPS speed sensors, are preferably mounted to the toolbar 14 or to the row unit 200. A downforce actuator 218, such as an air bag, hydraulic or pneumatic cylinder or the like, acts on the parallel linkage 16 to exert a downforce on the row unit. The downforce valve 390, such as an electrically operated servo valve, controls the amount of downforce applied by the downforce actuator 218. Each row unit 200 further includes a front mounting bracket 220 to which is mounted a hopper support beam 222 and a subframe 224. The hopper support beam 222 supports a seed hopper 226 and a fertilizer hopper 228 as well as operably supporting a seed meter 230 and a seed tube 232. The subframe 224 operably supports a furrow opening assembly 234 and a furrow closing assembly 236.

[0019] In operation of the planter 10, the furrow opening assembly 234 of the row unit 200 cuts a furrow 38 into the soil surface 40 as the planter 10 is drawn through the field. The seed hopper 226, which holds the seeds to be planted, communicates a constant supply of seeds 42 to the seed meter 230. In some embodiments the planter 10 is a central-fill planter including a frame-mounted bulk hopper as is known in the art; in such embodiments the seed hopper 226 preferably comprises a small auxiliary hopper in seed communication with the bulk hopper. The seed meter 230 of each row unit 200 is preferably selectively engaged to the drive 172 via the clutch 170 such that individual seeds 42 are metered and discharged into the seed tube 232 at regularly spaced intervals based on the seed population desired and the speed at which the planter is drawn through the field. The drive 172 and clutch 170 may be of the types disclosed in Applicant's U.S.

Patent Application No. 12/228,075 incorporated herein in its entirety by reference. In other embodiments, the clutch 170 is omitted and the drives 172 comprise electric drives such as those disclosed in Applicant's International Patent Application No. PCT/US2013/051971, incorporated herein in its entirety by reference. The seed sensor 305, preferably an optical sensor, is supported by the seed tube 232 and disposed to detect the presence of seeds 42 as they pass. The seed 42 drops from the end of the seed tube 232 into the furrow 38 and the seeds 42 are covered with soil by the closing wheel assembly 236.

[0020] The furrow opening assembly 234 can include a pair of furrow opening disk blades 244 and a pair of gauge wheels 248 selectively vertically adjustable relative to the disk blades 244 by a depth adjusting mechanism 268. The depth adjusting mechanism 268 preferably pivots about the downforce sensor 392, which preferably comprises a pin instrumented with strain gauges for measuring the force exerted on the gauge wheels 248 by the soil 40. The downforce sensor 392 is preferably of the type disclosed in Applicant's U.S. Patent Application No. 12/522,253, incorporated herein in its entirety by reference. In other embodiments, the downforce sensor is of the types disclosed in U.S. Patent No. 6,389,999, incorporated herein in its entirety by reference. The disk blades 244 are rotatably supported on a shank 254 depending from the subframe 224. Gauge wheel arms 260 pivotally support the gauge wheels 248 from the subframe 224. The gauge wheels 248 are rotatably mounted to the forwardly extending gauge wheel arms 260.

[0021] Referring to FIG. 2B, the GPS receiver 166 is preferably mounted to an upper portion of the tractor 5. The display device 130, communication module 120, and monitor device 110 are mounted in a cab 7 of the tractor 5. One or more speed sensors 168, such as a hall-effect wheel speed sensor or a radar speed sensor, are preferably mounted to the tractor 5.

[0022] Control module 112 cooperates with a Global Positioning System (GPS) 166 and is configured to access a desired row cleaner downforce prescription map for setting and/or modifying the desired row cleaner downforce as the planter traverses the field. The row cleaner downforce prescription map may be based upon soil types, elevations, or location-specific preferences set by the operator prior to operation. In such an embodiment, the control module 112 may be used to specify a different desired row cleaner downforce to each row unit or groups of row units to more accurately follow the row cleaner downforce prescription map. For example, if the locations of the far right row unit and the far left row unit on the planter

correspond to different prescribed desired row cleaner downforces based on soil type or other predefined factor, the control module 12 is preferably capable of setting the appropriate desired row cleaner downforce for each of the row units.

Monitor system operation

[0023] In operation, the monitor system 100 of FIG. 3 preferably carries out a process designated generally by reference numeral 1200 in FIG. 4. Referring to FIG. 4 in combination with FIG. 3, at step 1205, the communication module 120 optionally performs an authentication routine in which the communication module 120 receives a first set of authentication data 190 from the monitor device 110 and the authentication chip 122 compares the authentication data 190 to a key, token or code stored in the memory 126 of the communication module 120 or which is transmitted from the display device 130. If the authentication data 190 is correct, the communication module 120 preferably transmits a second set of authentication data 191 to the display device 130 such that the display device 130 permits transfer of other data between the monitor device 110 and the display device 130 via the communication module 120 as indicated in FIG. 3.

[0024] At step 1210, the monitor device 110 accepts configuration input entered by the user via the GUI 112. In some embodiments, the GUI 112 may be omitted and configuration input may be entered by the user via the GUI 132 of the display device 130. The configuration input comprises parameters preferably including dimensional offsets between the GPS receiver 166 and the row cleaners 1000. The monitor device 110 can then transmit the resulting configuration data 188 to the display device 130 via the communication module 120 as indicated in FIG. 3.

[0025] At step 1212, the display device 130 can access prescription data file 186 from the cloud storage server 140 or any other stored source. The prescription data file 186 can include a file (e.g., a polygon data file) containing geographic boundaries (e.g., a field boundary) and relating geographic locations (e.g., GPS coordinates) to operating parameters (e.g., row cleaner downforce). The display device 130 preferably allows the user to edit the prescription data file 186 using the GUI 132. The display device 130 preferably reconfigures the prescription data file 186 for use by the monitor device 110 and transmits resulting prescription data 185 to the monitor via the communication module 120.

[0026] At step 1214, as the planter 10 is drawn through the field, the monitor device 110 sends command signals 198 to the row cleaners 1000.

[0027] At step 1215, as the planter 10 is drawn through the field, the monitor device 110 can receive raw as-applied data 181. The monitor device 110 preferably processes the raw as-applied data 181, and stores the as-applied data to the memory 114. The monitor 130 preferably transmits processed as-applied data 182 to the display device 130 via the communication module 120. The processed as-applied data 182 is preferably streaming, piecewise, or partial data.

[0028] It should be appreciated that according to the method 1200, implement control and data storage are performed by the monitor device 110 such that if the display device 130 stops functioning, is removed from the monitor system 100, or is used for other functions, the implement operations and essential data storage are not interrupted.

[0029] At step 1220, the display device 130 receives and stores the live processed as-applied data 182 in the memory 134. At step 1225, the display device 130 preferably renders a map of the processed as-applied data 182 (e.g., a row cleaner downforce map) as described more fully elsewhere herein. The map can include a set of application map images superimposed on an aerial image. At step 1230, the display device 130 preferably displays a numerical aggregation of as-applied data. At step 1235, the display device 130 preferably stores the location, size and other display characteristics of the application map images rendered at step 1225 in the memory 134. At step 1238, after completing planting operations, the display device 130 preferably transmits processed as-applied data file 183 to the cloud storage server 140. Processed as-applied data file 183 is preferably a complete file (e.g., a data file). At step 1240 the monitor device 110 preferably stores completed as-applied data (e.g., in a data file) in the memory 114.

[0030] FIG. 5 illustrates monitor 110 displaying a prescription map 500. There are one or more zones 510 (510-A, 510-B, and 510-C) on prescription map 100 that each require a different amount of row cleaner applied force. FIG. 5 illustrates a four row unit planter 10, but the number or row units can be any number. As planter 10 drawn by tractor 5 passes over zone 510, the force applied to row cleaner 1000 (1000-1, 1000-2, 1000-3, 1000-4) is adjusted based on the prescription for that zone 510.

EXAMPLES

[0031] The following are non-limiting examples.

[0032] Example 1 - a method comprising: loading a row cleaner prescription map into a monitor, wherein the monitor is associated with controlling a row cleaner on an agricultural implement; traversing the agricultural implement across a field; and adjusting a force applied to

the row cleaner according to the prescription map as the agricultural implement traverses the field.

[0033] Example 2 - the method of Example 1, wherein there are a plurality of row units and each row unit is adjusted independent from other row units.

[0034] Example 3 - the method of Example 1, wherein there are a plurality of row units, and the row units are grouped into sections, and each section is adjusted independent from other sections.

[0035] Example 4 - the method of any preceding Example further comprising measuring and recording an applied force for each row unit at a location in the field.

[0036] Example 5 - the method of any preceding Example, wherein the agricultural implement is a planter.

[0037] Example 6 - the method of any preceding Example, wherein the agricultural implement is a strip till implement.

[0038] The foregoing description is presented to enable one of ordinary skill in the art to make and use the invention and is provided in the context of a patent application and its requirements. Various modifications to the preferred embodiment of the apparatus, and the general principles and features of the system and methods described herein will be readily apparent to those of skill in the art. Thus, the present invention is not to be limited to the embodiments of the apparatus, system and methods described above and illustrated in the drawing figures, but is to be accorded the widest scope consistent with the spirit and scope of the appended claims.

CLAIMS

1. A method comprising:

a. loading a row cleaner prescription map into a monitor, wherein the monitor is associated with controlling a row cleaner on an agricultural implement;

b. traversing the agricultural implement across a field; and

c. adjusting a force applied to the row cleaner according to the prescription map as the agricultural implement traverses the field.

2. The method of claim 1, wherein there are a plurality of row units and each row unit is adjusted independent from other row units.

3. The method of claim 1, wherein there are a plurality of row units, and the row units are grouped into sections, and each section is adjusted independent from other sections.

4. The method of any preceding claim further comprising measuring and recording an applied force for each row unit at a location in the field.

5. The method of any preceding claim, wherein the agricultural implement is a planter.

6. The method of any preceding claim, wherein the agricultural implement is a strip till implement.

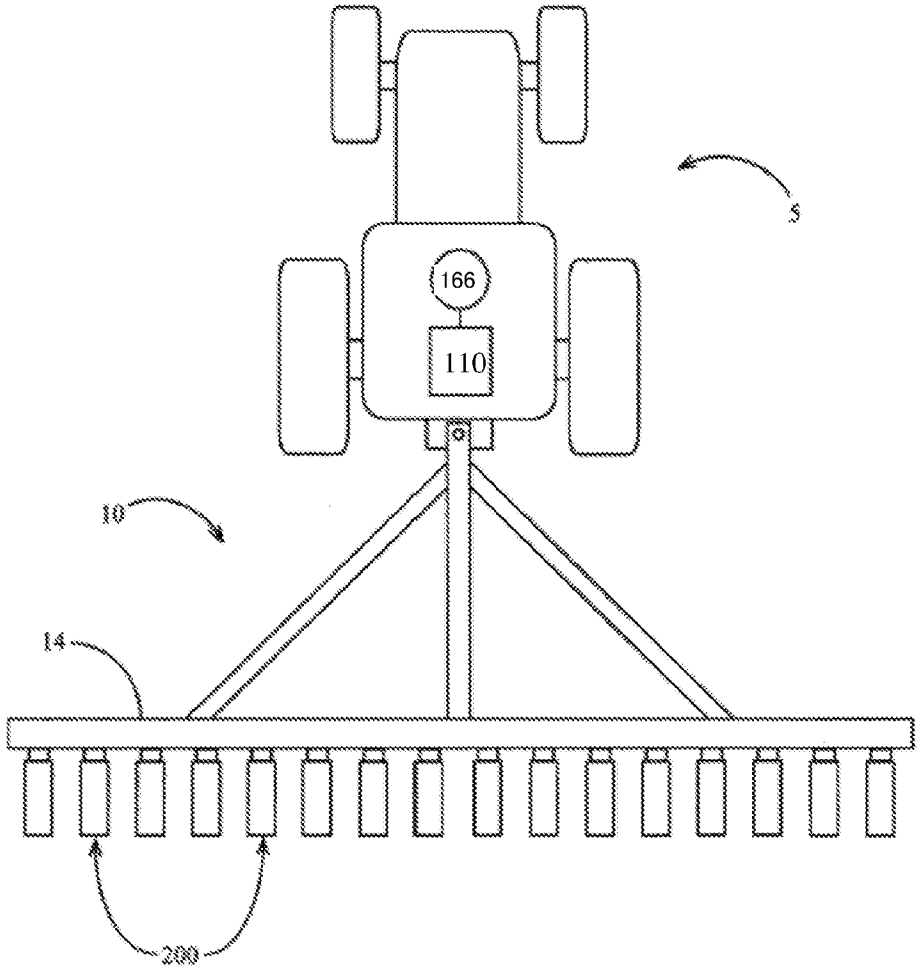

FIG. 1

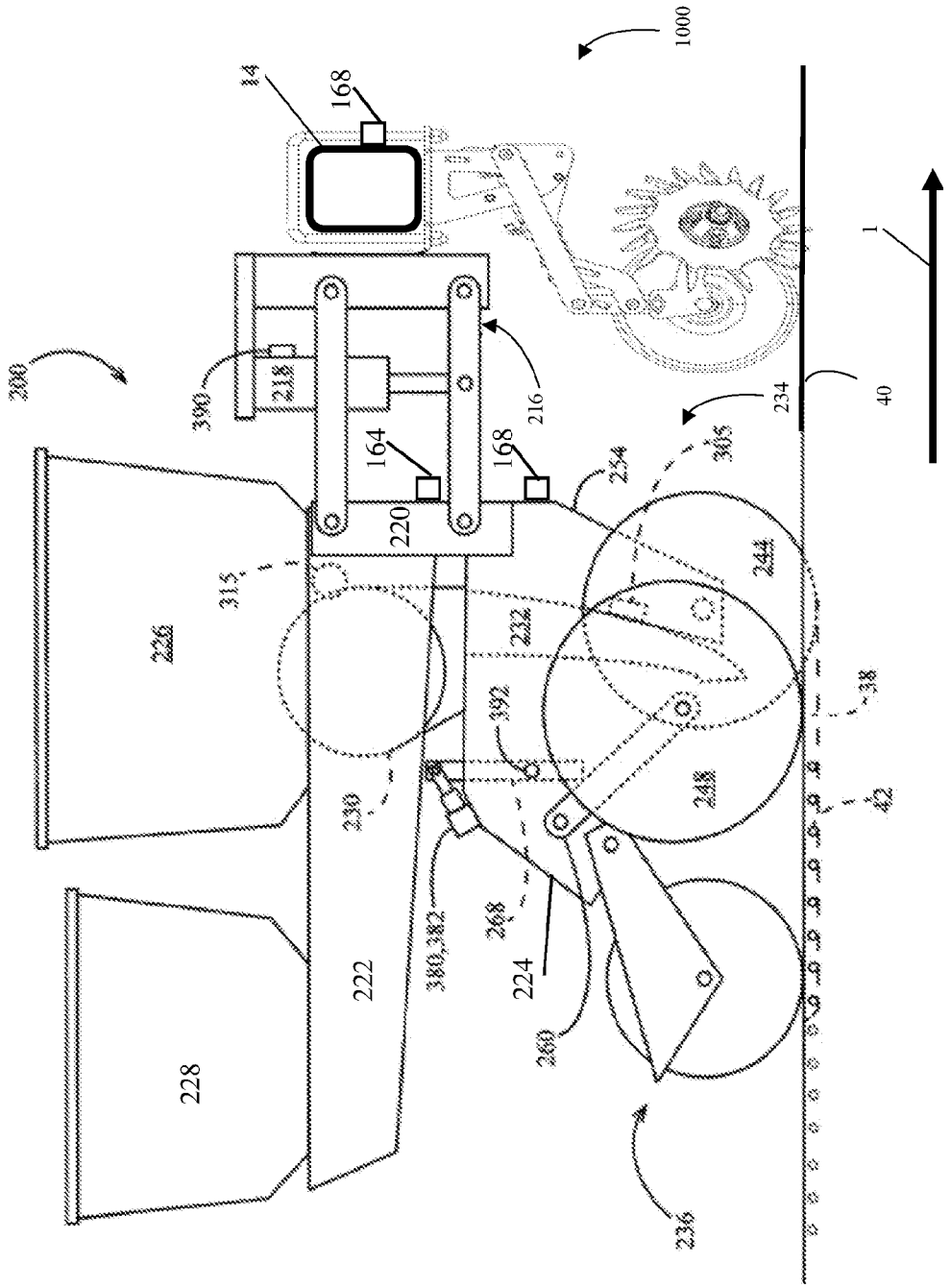
1000
14
168
1
200
390
218
216
164
168
220
234
40
254
305
315
244
226
232
38
392
230
248
42
222
380,382
268
224
228
260
236

FIG. 2A

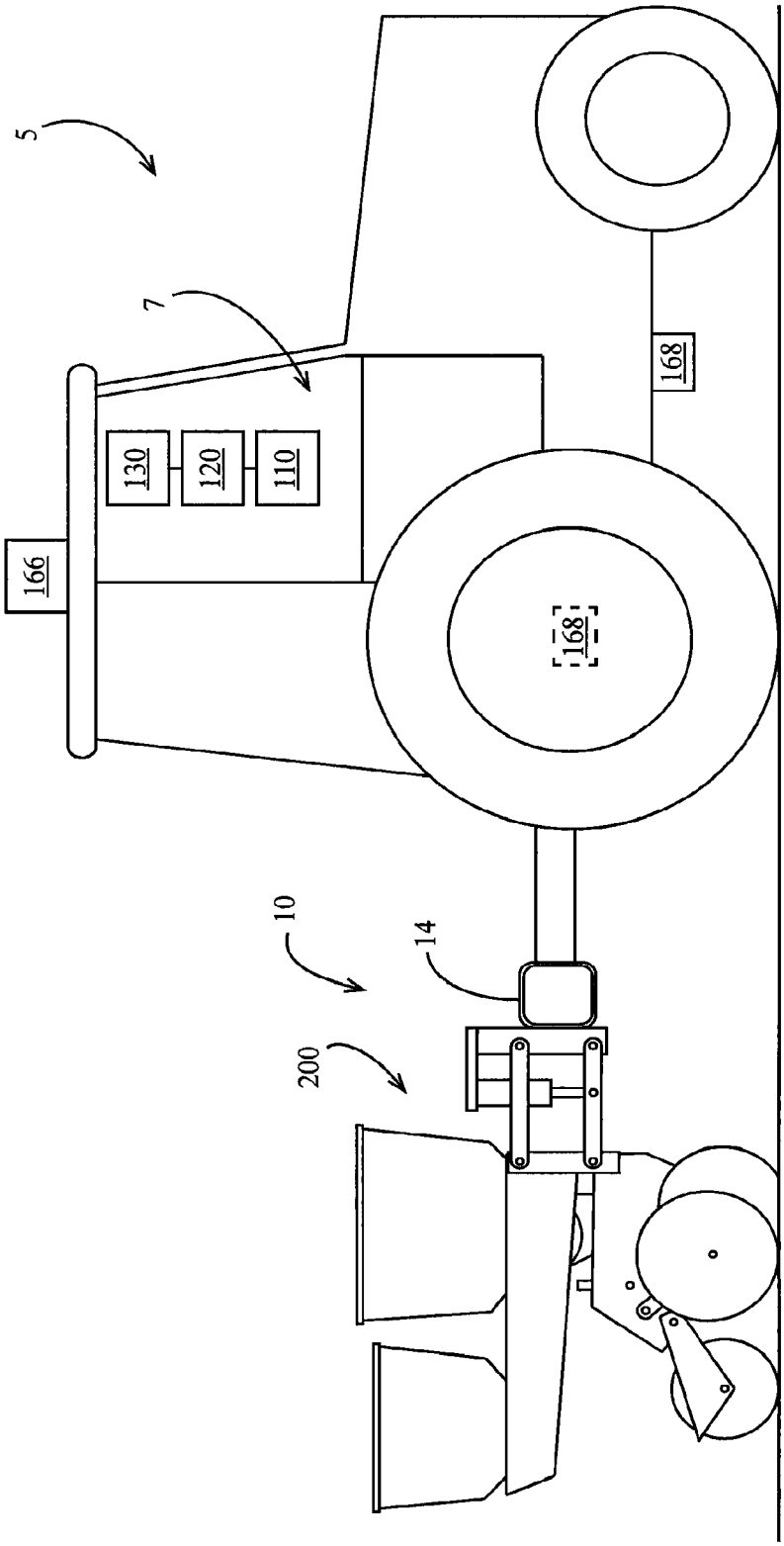

FIG. 2B

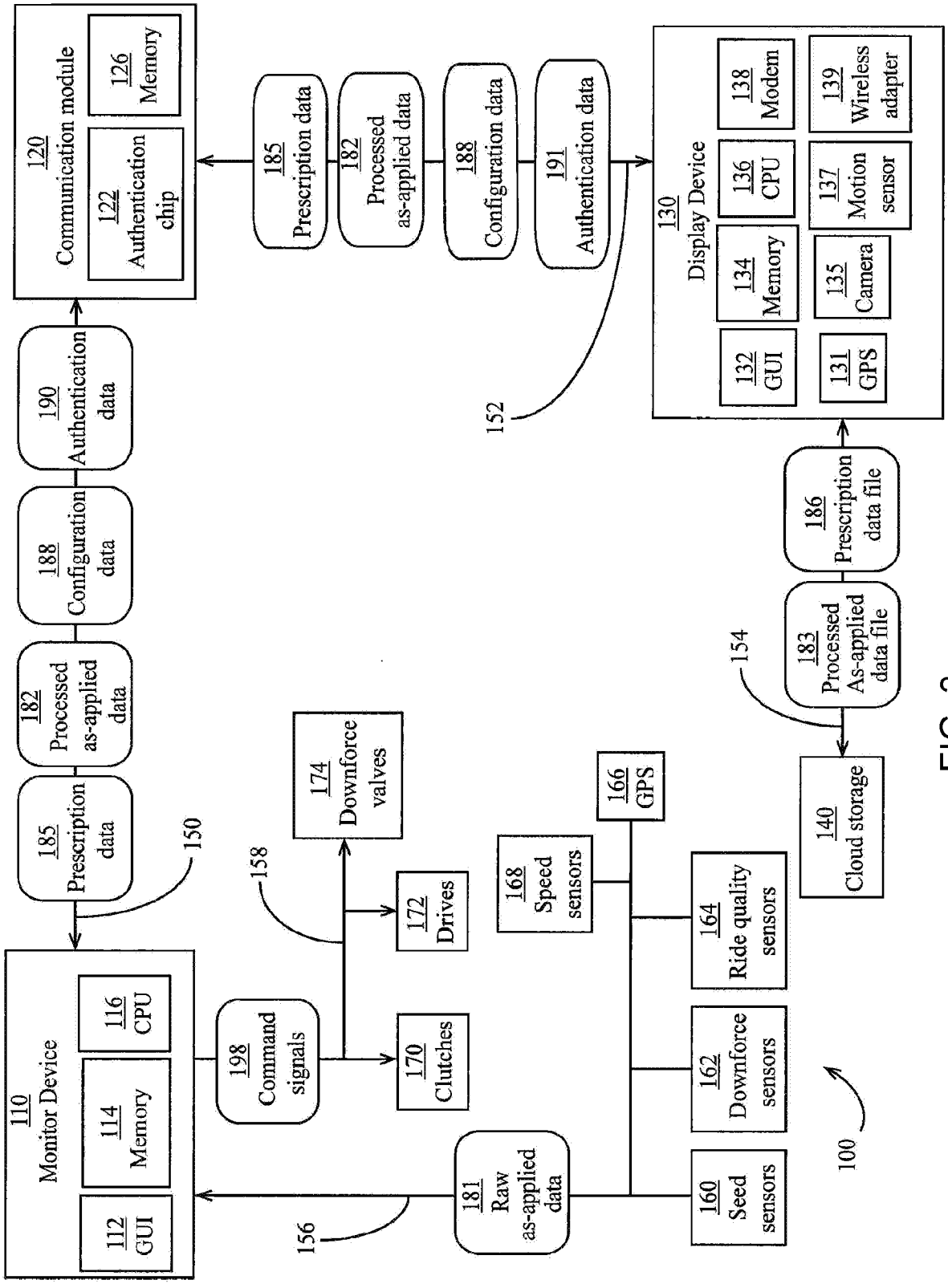
110 Monitor Device
112 GUI
114 Memory
116 CPU
120 Communication module
122 Authentication chip
126 Memory
130 Display Device
131 GPS
132 GUI
134 Memory
135 Camera
136 CPU
137 Motion sensor
138 Modem
139 Wireless adapter
140 Cloud storage
150
152
154
156
158
160 Seed sensors
162 Downforce sensors
164 Ride quality sensors
166 GPS
168 Speed sensors
170 Clutches
172 Drives
174 Downforce valves
181 Raw as-applied data
182 Processed as-applied data
183 Processed As-applied data file
185 Prescription data
186 Prescription data file
188 Configuration data
190 Authentication data
191 Authentication data
198 Command signals
100

FIG. 3

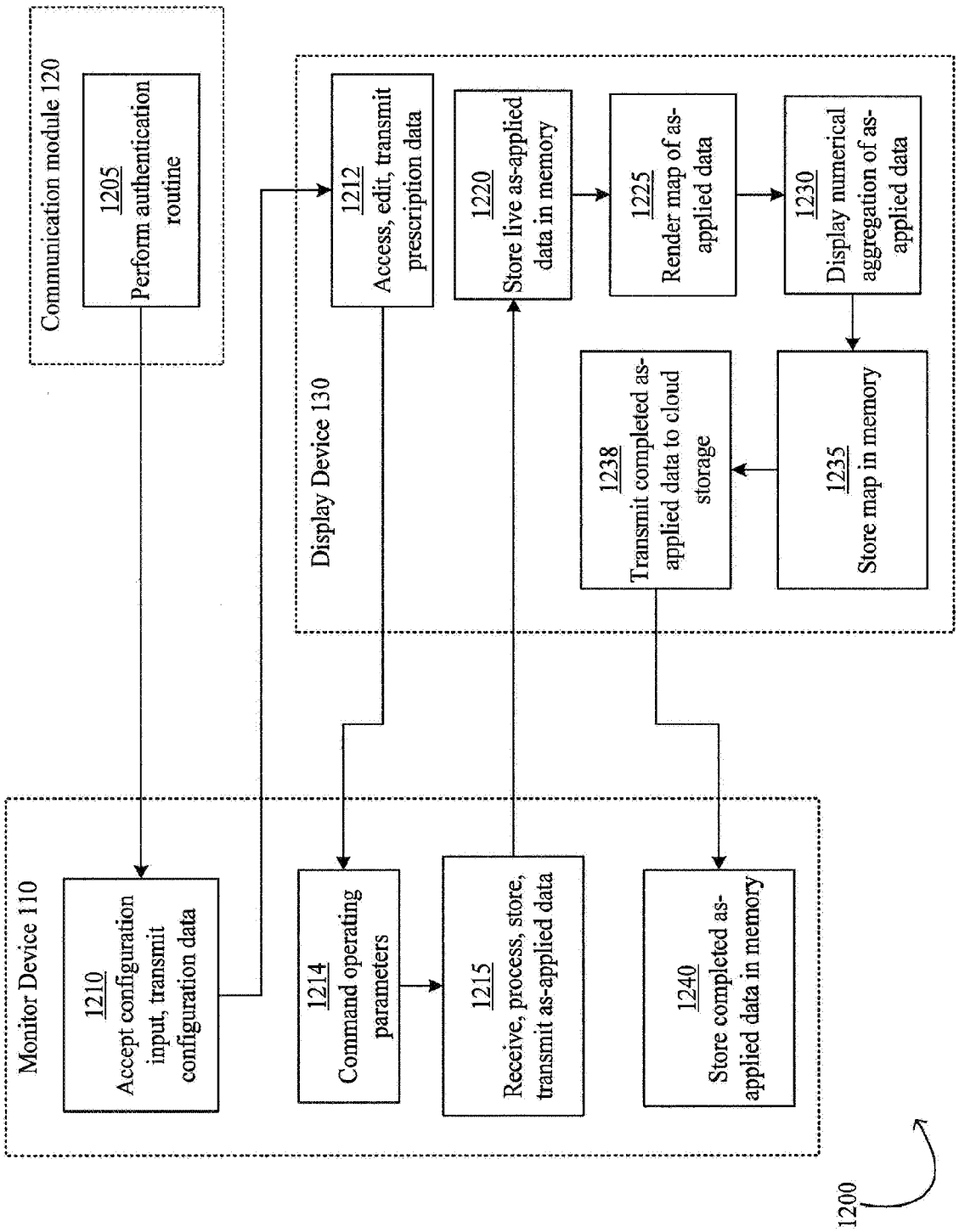
Communication module 120
1205
Perform authentication routine
Display Device 130
1212
Access, edit, transmit prescription data
1220
Store live as-applied data in memory
1225
Render map of as-applied data
1230
Display numerical aggregation of as-applied data
1238
Transmit completed as-applied data to cloud storage
1235
Store map in memory
Monitor Device 110
1210
Accept configuration input, transmit configuration data
1214
Command operating parameters
1215
Receive, process, store, transmit as-applied data
1240
Store completed as-applied data in memory
1200

FIG. 4

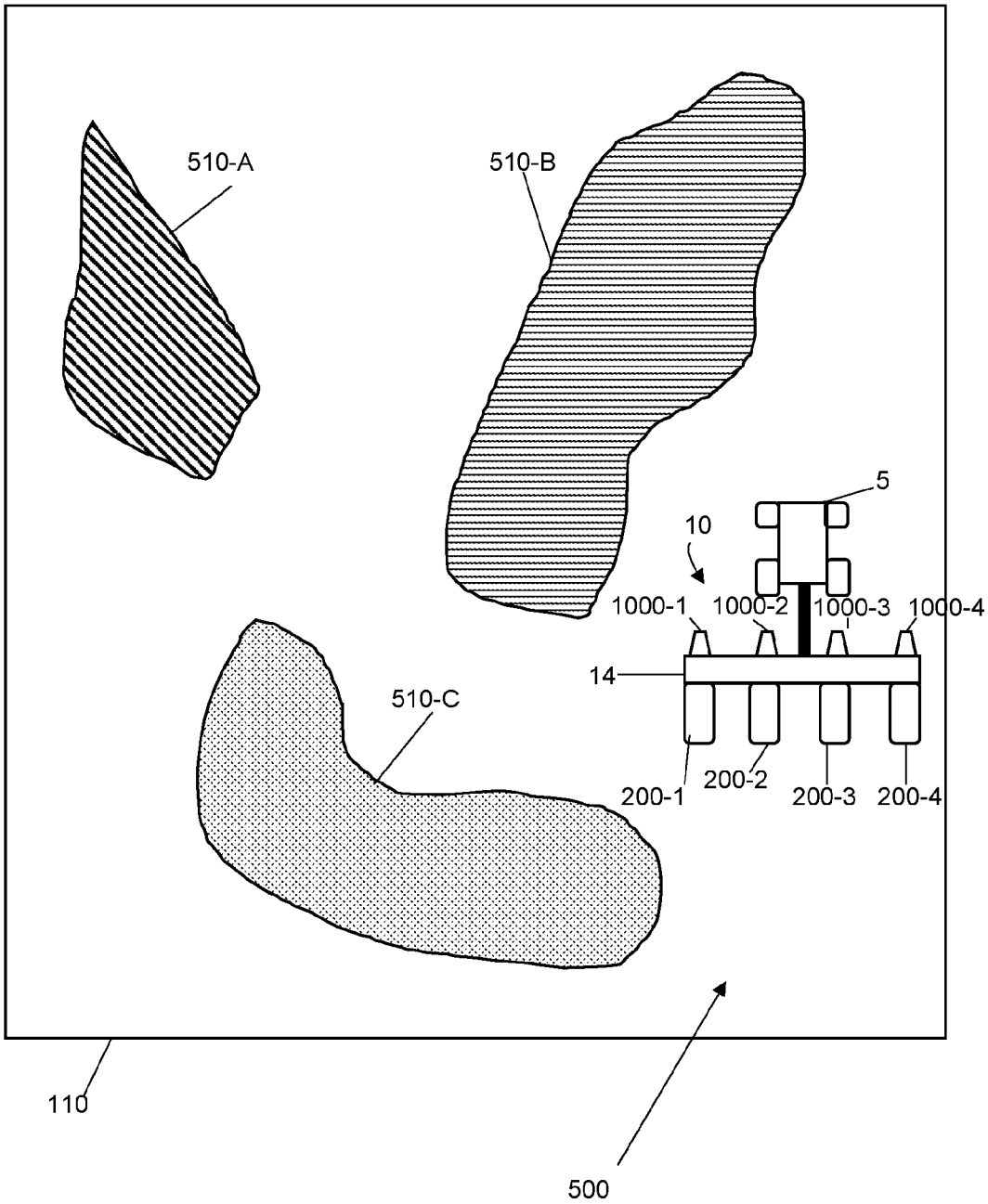
510-A
510-B
510-C
5
10
1000-1
1000-2
1000-3
1000-4
14
200-1
200-2
200-3
200-4
110
500

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/061924

A. CLASSIFICATION OF SUBJECT MATTER
INV. A01C7/20 A01B79/00
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
A01C A01B

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 10 679 341 B2 (CLIMATE CORP [US]) 9 June 2020 (2020-06-09) column 3, line 63 - column 4, line 4 figure 7	1-6
X	WO 2019/070617 A1 (PREC PLANTING LLC [US]) 11 April 2019 (2019-04-11) page 28 - page 32 page 34, line 26 - line 27	1-6
X	US 10 768 331 B2 (CLIMATE CORP [US]) 8 September 2020 (2020-09-08) column 10, line 4 - line 22 figure 7	1-6

-/--

[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

* Special categories of cited documents :

"A" document defining the general state of the art which is not considered to be of particular relevance

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"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance;; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance;; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 March 2022	07/04/2022

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Rapenne, Lionel

2

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No
PCT/IB2021/061924

C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2019/373797 A1 (SCHOENY CHRISTOPHER [US] ET AL) 12 December 2019 (2019-12-12) paragraph [0035] figure 2	1-6
X	US 2020/359559 A1 (KOCH DALE [US] ET AL) 19 November 2020 (2020-11-19) paragraph [0041] figure 1	1-6

2

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
PCT/IB2021/061924

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 10679341 B2	09-06-2020	AR 104567 A1	02-08-2017
		AU 2016261331 A1	14-12-2017
		BR 112017024044 A2	24-07-2018
		CA 2985359 A1	17-11-2016
		EP 3295224 A1	21-03-2018
		US 2018114305 A1	26-04-2018
		US 2019244339 A1	08-08-2019
		US 2020302586 A1	24-09-2020
		US 2022058785 A1	24-02-2022
		WO 2016182906 A1	17-11-2016
		ZA 201707982 B	29-05-2019
WO 2019070617 A1	11-04-2019	AU 2018345735 A1	23-04-2020
		BR 112020005882 A2	29-09-2020
		CA 3075884 A1	11-04-2019
		CN 111386031 A	07-07-2020
		EP 3691436 A1	12-08-2020
		US 2020221632 A1	16-07-2020
		US 2020225206 A1	16-07-2020
		US 2020245527 A1	06-08-2020
		US 2020245528 A1	06-08-2020
		US 2020249218 A1	06-08-2020
		US 2022074913 A1	10-03-2022
		WO 2019070617 A1	11-04-2019
US 10768331 B2	08-09-2020	AR 110141 A1	27-02-2019
		AU 2017355315 A1	13-06-2019
		BR 112019009310 A2	15-10-2019
		CA 3043200 A1	11-05-2018
		EP 3534685 A1	11-09-2019
		US 2018128933 A1	10-05-2018
		WO 2018085095 A1	11-05-2018
		ZA 201903414 B	30-09-2020
US 2019373797 A1	12-12-2019	BR 102019011171 A2	07-01-2020
		CA 3042427 A1	12-12-2019
		US 2019373797 A1	12-12-2019
US 2020359559 A1	19-11-2020	AU 2018370124 A1	28-05-2020
		BR 112020008752 A2	20-10-2020
		CA 3084468 A1	23-05-2019
		CN 111356356 A	30-06-2020
		EP 3709787 A1	23-09-2020
		US 2020359559 A1	19-11-2020
		WO 2019099748 A1	23-05-2019