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(54) **DOWN AND/OR UP FORCE ADJUSTMENT SYSTEM**

SYSTEM ZUR EINSTELLUNG EINER ABWÄRTS UND/ODER AUFWÄRTS WIRKENDEN KRAFT

SYSTÈME D'AJUSTEMENT DE FORCE VERS LE BAS ET/OU VERS LE HAUT

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Description

FIELD OF THE INVENTION

[0001] This invention relates generally to agricultural devices and, more particularly, to down force adjustment of a row unit of an agricultural device.

BACKGROUND

[0002] Implements for planting row crops, such as corn and soybeans, (planters) typically include row units laterally spaced along a frame, or toolbar. The row units generally include a seed channel opener that creates a channel or furrow in the soil for seed placement. Each row unit is mounted to the toolbar by means of a four-bar linkage or its equivalent which allows each row unit to move vertically to adjust to the contour of the soil independently of the other row units on the same toolbar. Some planters have springs in the four-bar linkage which work to transfer weight from the planter's frame to the row unit creating down force to help the seed channel opener penetrate the soil and to minimize row unit bounce in rough soil conditions. Insufficient down force can result in a seed furrow of inadequate depth or a seed furrow simply not formed, which in turn results in shallow seed placement or seed placement on the soil surface. However, too much down force could overly compact the seed bed or form the seed furrow too deep, which could negatively affect early plant development. Furthermore, excessive down force could accelerate wear on the row units' soil-engaging components. The springs can be adjusted to adjust the down force of the row unit. This adjustment usually is made by manually changing the position of the springs in the four-bar linkage.

[0003] In other planters, airbags are employed in the four-bar linkage which are similarly adapted to transfer weight from the planter's frame to the row unit creating down force to help the seed channel opener penetrate the soil and to minimize row unit bounce. In both of these conventional biasing means - springs and airbags - the system lacks accuracy and predictability. For instance, when the biasing means is an airbag, it can be difficult to precisely determine the volume of air in the airbag at a given time and, subsequently, determine needed supplemental down force.

GB2091073 discloses a seed drill having coulter actuation means comprising a beam connected to the coulters. Two pressure operated hydraulic devices are connected to the beam so as to operate the coulters via the beam, and that are connected in parallel in a hydraulic actuation circuit. Adjustable pressure relief means are connected to the actuation circuit to limit the pressure on the supply side of the hydraulic devices to a pre-selected value corresponding to a required depth of penetration of the coulters when lowering them into work.

DE8412142 U discloses a seed drill machine comprising a frame, sowing coulters that are disposed relative to the frame and a measuring device for measuring the depth of the sowing coulters in the soil and allowing adjustment. A reservoir for receiving seed is arranged relative to the sowing coulters and the measuring device regulates the depth of the sowing coulters by also using the weight of the seed reservoir.

GB 2 126 062 A discloses a row unit adjustment system and method according to the preambles of claims 11 and 13.

[0004] It is desirable to be able to adjust down force on a row unit quickly and accurately so that a consistent seed depth is maintained. It is also desirable to be able to lift the row unit if its own weight is applying too much down force to the soil.

SUMMARY

[0005] Accordingly, it is an object of the present invention to provide for a quick and accurate adjustment of the down force on a row unit during planting.

[0006] It is another object of the present invention to provide the capability to put both positive and negative pressure on the row unit.

[0007] These and other objects are achieved by the present invention. In some embodiments of the present invention, a row unit of a planter is provided. The row unit is mounted to a toolbar of a planter by means of a four-bar linkage having a set of top and bottom parallel arms. At least one spring is provided between the top and bottom arms and connected at one end to the bottom arm in a fixed manner at a connection point. The other end of the spring is connected to a spring mount that is disposed on the top arm and coupled to an electric actuator. The spring mount is longitudinally movable in both directions of the top arm. The electric actuator moves the spring mount forward and backward along the top arm, which adjusts the down or up force placed on the row unit, which in turn can increase or decrease the soil penetration of a seed channel opener component of the row unit, and keep the row unit from bouncing in rough soil conditions.

[0008] In one aspect of the present invention, an agricultural device is provided according to claim 1.

[0009] In a further aspect of the present invention, a row unit adjustment system for use in an agricultural planter for planting seeds is provided according to claim 11.

[0010] In a still further aspect, a method for adjusting a force applied to a row unit of an agricultural planter is provided according to claim 13.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The appended claims set forth those novel features which characterize the invention. However, the invention itself, as well as further objects and advantages thereof, will best be understood by reference to the following detailed description of an exemplary embodiment,

taken in conjunction with the accompanying drawings, where like reference characters identify the elements throughout the various figures in which:

FIG. 1 is a side elevation view of a portion of an exemplary planter row unit, the exemplary row unit including an exemplary down force adjustment system;

FIG. 2 is a side elevation view similar to FIG. 1 showing a down force spring of an exemplary down force adjustment system adjusted to provide a negative down force on the row unit;

FIG. 3 is a side elevation view similar to FIGS. 1 and 2 showing a down force spring of an exemplary down force adjustment system adjusted to provide a positive down force on the row unit;

FIG. 4 is an exemplary system diagram of the present invention; and

FIG. 5 is a side elevation view of a portion of an exemplary planter row unit including an exemplary soil characteristic sensor.

[0012] Before any independent features and embodiments of the invention are explained in detail, it is to be understood that the invention is not limited in its application to the details of the construction and the arrangement of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced or of being carried out in various ways. Also, it is understood that the phraseology and terminology used herein is for the purpose of description and should not be regarded as limiting.

DETAILED DESCRIPTION

[0013] The contents of U.S. Patent Application No. 13/458,012, filed April 27, 2012, entitled "AGRICULTURAL DEVICES, SYSTEMS, AND METHODS FOR DETERMINING SOIL AND SEED CHARACTERISTICS AND ANALYZING THE SAME" and having attorney docket number KINZE-48 US-1, U.S. Patent Application No. 13/457,815, filed April 27, 2012, entitled "DOWN AND/OR UP FORCE ADJUSTMENT SYSTEM" and having attorney docket number KINZE-49 US-1, and U.S. Patent Application No. 13/457,577, filed April 27, 2012, entitled "REMOTE ADJUSTMENT OF A ROW UNIT OF AN AGRICULTURAL DEVICE" and having attorney docket number KINZE-50 US-1.

[0014] Referring to FIG. 1, there is shown a side elevation view of an exemplary planter row unit 10 in accordance with the principles of the present invention. A single row unit 10 is depicted in the figures and described herein for simplicity, but it is understood that a typical planter 36 (see FIG. 4) includes multiple row units 10. Row unit 10 includes a frame 12. Mounted to the lower section of frame 12 are a pair of furrow-opening discs 14 (one of which is seen in FIGS. 1-3), a pair of depth gauge wheels 16 (one of which is seen in FIGS. 1-3) and a pair of furrow closing wheels (not shown). As is known, seed is stored in a hopper (not shown), fed to and "singulated" by a meter (not shown) and deposited at desired spacing in the furrow formed by the furrow-opening discs 14. The furrow is then closed and soil is packed about the seed by the closing wheels.

[0015] The row unit 10 is mounted to a toolbar (not shown) by a conventional four-bar linkage 18. Four-bar linkage 18 includes parallel top arms 20 (one of which is seen in FIGS. 1-3) and parallel bottom arms 22 (one of which is seen in FIGS. 1-3) on each side of the row unit 10. The forward ends of the top arms 20 are pivotally connected to an upper portion of a mounting plate 24. Likewise, the forward ends of the bottom arms 22 are pivotally connected to a lower portion of the mounting plate 24. Mounting plate 24 is in turn coupled to the toolbar. A conventional mounting arrangement for attaching the mounting plate 24 to the toolbar would typically include threaded U-shaped bolts and mounting nuts which are not shown in the drawing for simplicity. The rear ends of top and bottom arms 20 and 22 are pivotally connected to row unit frame 12.

[0016] The top and bottom arms 20 and 22 are connected to both the mounting plate 24 and row unit frame 12 by means of a nut and bolt combination which allows the top and bottom arms 20 and 22 to pivot at both ends. The four-bar linkage 18 permits the row unit 10 to move vertically, independently of adjacent row units, while remaining laterally in place on the toolbar.

[0017] At least one linear actuator 26 is mounted to the mounting plate 24 above a top arm 20 of the linkage 18. In other exemplary embodiments, a linear actuator 26 may be provided above each top arm 20 of the linkage 18. Linear actuator 26 can be of an electric, hydraulic or air type, having a shaft 28 that extends longitudinally parallel to the top arm 20. A mounting bracket 30 is provided on top arm 20 and coupled to the shaft 28. The mounting bracket 30 engages and is supported by a top surface of top arm 20 and may slide, roll, or otherwise move along the top surface of the top arm 20. During up and down movement of the row unit 10, shaft 28 pivots about pin or pivot 29 to maintain the shaft 28 substantially parallel to the top arm 20. At least one biasing member 32 under tension is provided between top and bottom arms 20, 22. In the illustrated exemplary embodiment, the biasing member 32 is a spring or coil spring. However, it should be understood that the biasing member 32 may be any type of biasing member and other types of springs and still be within the intended spirit and scope of the present invention. In exemplary embodiments including an actuator 26 above each top arm 20, two tension springs 32 may be included in the linkage 18 with one spring 32 coupled to each actuator 26. In other exemplary embodiments, one actuator 26 and two springs 32 may be included in the linkage 18 with one spring 32 coupled to the actuator 26 and the second spring 32 coupled to and between the top and bottom arms 20, 22. In the illustrated

exemplary embodiment, the spring 32 is connected at a lower end to the bottom arm 22 at a fixed point and at an upper end to the mounting bracket 30 on the top arm 20. The tension applied across the tension spring 20 may be varied to adjust the tension on spring 32 and thus the amount of weight transferred from the toolbar to the row unit 10 by extending or retracting the shaft 28 of the actuator 26, which in turn will move the mounting bracket 30 forward or rearward along the top arm 20. Alternatively, the actuator 26 may be a screw-drive type actuator 26, and the shaft 28 and the mounting bracket 30 may have a screw or threaded engagement between the two components, thereby causing the mounting bracket to translate along the shaft 28 as the shaft 28 rotates. The shaft 28 may rotate either direction to enable the mounting bracket 30 to translate in either direction.

[0018] With continued reference to FIG. 1, *dt* denotes the distance between the proximal pivot point of the top arm 20 and the mounting bracket 30, which is the connection point of the upper end of the spring 32, and *db* denotes the distance between the proximal pivot point of the bottom arm 22 and the fixed connection point of the lower end of the spring 32. As shown in FIG. 1, when *dt* and *db* are the same, the spring 32 is in a neutral position where the net effect on the force applied to the soil Fg is zero. As shown in FIG. 2, when the actuator 26 retracts the shaft 28, the mounting bracket 30 is moved to a position closer to the proximal pivot point of top arm 20. In this position the spring 32 is in a negative, or up force position in which *dt* is less than *db*, and where a net negative force will be put on the row unit 10 which decreases the force applied to the soil by the furrow-opening discs 14.

[0019] As shown in FIG. 3, when the actuator 26 extends the shaft 28, the mounting bracket 30 is moved to a position further from the proximal pivot point of top arm 20. In this position, the spring 32 is in a positive, or down force position in which *dt* is greater than *db,* and where a net positive force will be applied to the row unit 10. This increases the force that is applied to the soil by the furrow-opening discs 14.

[0020] With continued reference to FIGS. 1-3, an exemplary sensor 34 is provided to sense or determine a position of the biasing member 32. In the illustrated exemplary embodiment, the sensor 34 is coupled to the mounting plate 24. In other exemplary embodiments, the sensor 34 may be coupled to any portion of the toolbar, linkage 18, row unit 10, etc. and still be within the intended spirit and scope of the present invention. The sensor 34 may be any type of sensor for determining a position of the biasing member 32. For example, the sensor 34 may be an ultrasonic sensor, a laser sensor, a potentiometer, a hall effect sensor, or any other type of sensor. In other exemplary embodiments, the sensor 34 may be coupled to or included within the actuator 26 and may be a wide variety of types of sensors such as, for example, a potentiometer, a hall effect sensor, etc.

[0021] The actuator 26 is controlled by conventional means via a user interface 40, which can be in the cab of a tractor 38 that pulls the planter 36 and row units 10 through a field. In this way, a farmer can adjust down force on the row unit 10 quickly and accurately so that furrow-opening discs 14 can maintain a consistent furrow depth, or the farmer can lift the row unit 10 if its own weight is applying too much down force to the soil.

[0022] Referring now to FIG. 4, an exemplary system of the present invention is illustrated and includes a tractor 38 and a planter 36. The tractor 38 includes a control system 39 including a user interface 40 with an optional touch screen 42 and associated touch screen capabilities, a processing unit 44, an optional mechanical control panel 46, and a memory 48. The tractor 38 also includes a tractor electrical power source 50. The planter 36 includes multiple row units 10, however, since the row units 10 are substantially identical, only one row unit 10 is illustrated with further detail and described herein. Each row unit 10 includes a down force adjustment assembly including the actuator 26, the biasing member position sensor 34, a down force sensor 52, and a soil characteristic sensor 54 (see FIGS. 4 and 5). Each row unit 10 may include an optional row unit electrical power source 56 and the planter 36 further includes a planter electrical power source 58. In other exemplary embodiments, the planter 36 may include a processing unit and/or the row units 10 may each include a processing unit and the processing unit(s) of the planter 36 and/or the row units 10 may communicate with the processing unit 44 of the tractor 38 via a communication bus.

[0023] The down force sensor 52 may be, for example, a force transducer that is coupled to a depth-adjusting lever mechanism 60 (see FIG. 5) or the gauge wheels 16 for monitoring and/or measuring a down force occurring in the depth-adjusting mechanism 60 or the gauge wheels 16 and applied to the row unit 10 to force the row unit 10 downward toward the soil. The down force sensor 52 may be any type of sensor such as, for example, a load cell, a pressure sensor, a potentiometer, etc., and may be coupled to any portion of the row unit 10 as long as it can operate appropriately to sense a down force. Such a force sensor 52 may be electronically coupled to the processing unit 44 to enable the processing unit 44 to take readings of the down force and display related information to a user via the user interface 40 or to enable the processing unit 44 to communicate with the necessary components to adjust the down force.

[0024] With further reference to FIG. 5, an exemplary soil characteristic sensor 54 is illustrated and may be coupled to the row unit 10 in any manner and at any location as long as the sensor 54 can sense desired soil characteristic(s). The soil characteristic sensor 54 may sense any soil characteristic and operate in any of the manners described in U.S. Provisional Patent Application Nos. 61/479,537 and 61/479,543, both of which were filed April 27, 2011.

[0025] All of the sensors may generate a signal associated with the characteristic they are sensing and com-

municate with the processing unit so the processing unit may receive the signals, interpret the signals, and react accordingly to perform the desired functions of the system.

[0026] It should be understood that the sensors described and illustrated herein may be any type of sensor and be within the intended scope of the present invention. Exemplary sensors include, but are not limited to, ultrasonic sensors, laser sensors, video cameras, infra-red sensors, infra-red cameras, infra-red scanners, microwave sensors, potentiometers, hall effect sensors, force transducers, etc.

[0027] The foregoing description has been presented for purposes of illustration and description, and is not intended to be exhaustive or to limit the invention to the precise form disclosed. The descriptions were selected to explain the principles of the invention and their practical application to enable others skilled in the art to utilize the invention in various embodiments and various modifications as are suited to the particular use contemplated. Although particular constructions of the present invention have been shown and described, other alternative constructions will be apparent to those skilled in the art and are within the intended scope of the present invention as defined by the appended claims.

[0028] While particular embodiments of the present invention have been illustrated and described, it will be obvious to those skilled in the relevant arts that changes and modifications may be made without departing from the invention as defined by the appended claims. Therefore, the aim in the appended claims is to cover all such changes and modifications that fall within the scope of the invention. The matters set forth in the foregoing description and accompanying drawings is offered by way of illustration only and not as a limitation. The actual scope of the invention is intended to be defined in the following claims when viewed in their proper perspective based on the prior art.

Claims

1. An agricultural device (36) comprising:

a toolbar;
a row unit (10);
a linkage (18) coupling the row unit to the toolbar, wherein the linkage (18) includes a first arm (20) and a second arm (22), and wherein each of the first arm (20) and the second arm (22) includes a first end coupled to the toolbar and a second end coupled to the row unit (10), wherein the agricultural device (36) includes a row unit adjustment system comprising
an actuator (26) coupled to the toolbar;
a biasing member (32) coupled to the linkage (18) and the actuator (26), wherein the actuator (26) is adapted to move the biasing member (32) to vary an amount of force applied to the row unit (10); **characterised in that** the agricultural device (36) further includes a first sensor (52) adapted to sense a force applied to the row unit (10); and
a second sensor (54) adapted to sense a characteristic of a soil upon which the row unit (10) travels; wherein the first and second sensors generate a signal associated with the characteristic they are sensing and communicate with the processing unit so the processing unit may receive the signals, interpret the signals, and react to adjust the force applied to the row unit based upon the signals.

2. The agricultural device of claim 1, wherein the actuator (26) moves the biasing member (32) in a first direction to apply a down force to the row unit (10) and moves the biasing member (32) in a second direction to apply an up force to the row unit (10), and wherein the first and second directions are different directions.

3. The agricultural device of claim 1, wherein the actuator (26) is one of:

an electric actuator;
a hydraulic actuator;
a pneumatic actuator; and
a screw drive actuator.

4. The agricultural device of claim 1, further comprising a third sensor (34) adapted to sense a position of the biasing member (32).

5. The agricultural device of claim 4, wherein:

the third sensor (34) generates a signal associated with the position of the biasing member (32), and the agricultural device (36) further comprising a processing unit (44) in communication with the third sensor (34) to receive the signal and determine whether adjustment of the biasing member (32) is necessary based on the signal;
the first sensor (52) generates a signal associated with the force applied to the row unit (10), and the agricultural device (36) further comprising a processing unit (44) in communication with the first sensor (52) to receive the signal and determine whether adjustment of the biasing member (32) is necessary based on the signal; or
the second sensor (54) generates a signal associated with the characteristic of the soil, and the agricultural device (36) further comprising a processing unit (44) in communication with the second sensor (54) to receive the signal and de-

termine whether adjustment of the biasing member (32) is necessary based on the signal.

6. The agricultural device of claim 5, further comprising a user interface (40) in communication with the processing unit (44), and wherein any necessary adjustment required is communicated to the user interface (40) by the processing unit (44) and is displayed on the user interface (40).

7. The agricultural device of claim 5, wherein the processing unit communicates with the actuator (26) to adjust the biasing member (32) based on the signal.

8. The agricultural device of claim 5, further comprising a gauge wheel (16), and wherein the first sensor (52) senses a force applied to a gauge wheel (16).

9. The agricultural device of claim 4, 5, 6, 7, or 8, wherein the second sensor (54) is positioned at least partially behind a pair of furrow-opening discs (14).

10. The agricultural device of claim 1, wherein the biasing member (32) is a spring and includes a first end coupled to the first arm (20) and a second end coupled to the actuator (26).

11. A row unit adjustment system for use with an agricultural planter for planting seeds, the agricultural planter (36) including a toolbar, a row unit (10) coupled to the toolbar by a linkage (18), the row unit adjustment system comprising:

an actuator (26) including an adjustment member;
a biasing member (32) coupled to the linkage (18) and the adjustment member; wherein the system further includes
a plurality of sensors (52, 54) each adapted to sense a separate characteristic associated with planting seeds and to generate a signal associated with each of the sensed characteristics; and
a processing unit (44) receiving the signals associated with the sensed characteristics and determining whether adjustment of the biasing member (32) is necessary based on the signals; **characterised in that** the characteristics are:

a position of the biasing member and the signal is associated with the position of the biasing member;
a characteristic of a soil upon which the agricultural planter travels; and
a force applied to the row unit.

12. The row unit adjustment system of claim 11, wherein the characteristic of the soil is one of soil temperature, moisture content of soil, depth of a furrow, and soil type.

13. A method of adjusting a force applied to a row unit (10) of an agricultural planter (36), the agricultural planter (36) including a toolbar and the row unit (10) including a linkage (18) coupling the row unit (10) to the agricultural planter (36), the method comprising:

providing an actuator (26) including an adjustment member;
coupling a biasing member (32) at a first end to the linkage (18) and at a second end to the adjustment member;
sensing a plurality of characteristics associated with planting with a plurality of sensors (52, 54);
generating a signal associated with each of the characteristics with the sensors (52, 54);
communicating the signals to a processing unit (44); and
adjusting a position of the biasing member (32) with the actuator (26) based on the signals received by the processing unit (44) in order to adjust a force applied to the row unit (10); **characterised in that** sensing a plurality of characteristics includes sensing a position of the biasing member, a characteristic of a soil upon which the agricultural planter travels, and a force applied to the row unit.

14. The method of claim 13, wherein adjusting a position of the biasing member (32) further includes:

manually adjusting a position of the biasing member (32) after displaying information associated with the signal on a user interface (40); or
automatically adjusting a position of the biasing member (32) with the processing unit (44) based on the signal received by the processing unit (44).

Patentansprüche

1. Landwirtschaftliche Vorrichtung (36), die aufweist:

einen Geräteträger;
eine Reiheneinheit (10);
ein Verbindung (18), welche die Reiheneinheit mit dem Geräteträger koppelt, wobei die Verbindung (18) einen ersten Arm (20) und einen zweiten Arm (22) enthält und wobei der erste Arm (20) und der zweite Arm (22) jeweils ein erstes Ende, das mit dem Geräteträger gekoppelt ist, und ein zweites Ende, das mit der Reiheneinheit (10) gekoppelt ist, enthalten,
wobei die landwirtschaftliche Vorrichtung (36) ein Reiheneinheitseinstellsystem enthält, das

aufweist:

einen Stellantrieb (26), der mit dem Geräteträger gekoppelt ist;
ein Vorspannelement (32), das mit der Verbindung (18) und dem Stellantrieb (26) gekoppelt ist, wobei der Stellantrieb (26) zum Bewegen des Vorspannelements (32) zum Variieren eines auf die Reiheneinheit (10) angewendeten Kraftbetrags geeignet ist;
dadurch gekennzeichnet, dass die landwirtschaftliche Vorrichtung (36) ferner einen ersten Sensor (52), der zum Erfassen einer auf die Reiheneinheit (10) angewendeten Kraft geeignet ist; und
einen zweiten Sensor (54), der zum Erfassen einer Eigenschaft eines Bodens geeignet ist, auf dem die Reiheneinheit (10) fährt, enthält; wobei der erste und der zweite Sensor ein Signal erzeugen, das mit der Eigenschaft, die sie erfassen, assoziiert ist, und mit der Verarbeitungseinheit kommunizieren, so dass die Verarbeitungseinheit die Signale empfangen, die Signale interpretieren und zum Einstellen der auf die Reiheneinheit angewendeten Kraft auf Basis der Signale reagieren kann.

2. Landwirtschaftliche Vorrichtung nach Anspruch 1, wobei der Stellantrieb (26) das Vorspannelement (32) in einer ersten Richtung bewegt, um eine Abwärtskraft auf die Reiheneinheit (10) anzuwenden, und das Vorspannelement (32) in einer zweiten Richtung bewegt, um eine Aufwärtskraft auf die Reiheneinheit (10) anzuwenden, und wobei die erste und die zweite Richtung verschiedene Richtungen sind.

3. Landwirtschaftliche Vorrichtung nach Anspruch 1, wobei der Stellantrieb (26) einer der Folgenden ist:

ein elektrischer Stellantrieb;
ein hydraulischer Stellantrieb;
ein pneumatischer Stellantrieb und
ein Stellantrieb mit Schneckengetriebe.

4. Landwirtschaftliche Vorrichtung nach Anspruch 1, die ferner einen dritten Sensor (34) aufweist, der zum Erfassen einer Stellung des Vorspannelements (32) geeignet ist.

5. Landwirtschaftliche Vorrichtung nach Anspruch 4, wobei:

der dritte Sensor (34) ein Signal erzeugt, das mit der Stellung des Vorspannelements (32) assoziiert ist und die landwirtschaftliche Vorrichtung (36) ferner eine Verarbeitungseinheit (44) aufweist, die mit dem dritten Sensor (34) in Verbindung steht, um das Signal zu empfangen und auf Basis des Signals zu bestimmen, ob eine Einstellung des Vorspannelements (32) notwendig ist;
der erste Sensor (52) ein Signal erzeugt, das mit der auf die Reiheneinheit (10) angewendeten Kraft assoziiert ist, und die landwirtschaftliche Vorrichtung (36) ferner eine Verarbeitungseinheit (44) aufweist, die mit dem ersten Sensor (52) in Verbindung steht, um das Signal zu empfangen und auf Basis des Signals zu bestimmen, ob eine Einstellung des Vorspannelements (32) notwendig ist; oder
der zweite Sensor (54) ein Signal erzeugt, das mit der Eigenschaft des Bodens assoziiert ist, und die landwirtschaftliche Vorrichtung (36) ferner eine Verarbeitungseinheit (44) aufweist, die mit dem zweiten Sensor (54) in Verbindung steht, um das Signal zu empfangen und auf Basis des Signals zu bestimmen, ob eine Einstellung des Vorspannelements (32) notwendig ist.

6. Landwirtschaftliche Vorrichtung nach Anspruch 5, die ferner eine Benutzerschnittstelle (40) aufweist, die mit der Verarbeitungseinheit (44) in Verbindung steht, und wobei jedwede erforderliche notwendige Einstellung der Benutzerschnittstelle (40) durch die Verarbeitungseinheit (44) mitgeteilt wird und an der Benutzerschnittstelle (40) angezeigt wird.

7. Landwirtschaftliche Vorrichtung nach Anspruch 5, wobei die Verarbeitungseinheit mit dem Stellantrieb (26) kommuniziert, um das Vorspannelement (32) auf Basis des Signals einzustellen.

8. Landwirtschaftliche Vorrichtung nach Anspruch 5, die ferner ein Tastrad (16) aufweist und wobei der erste Sensor (52) eine auf ein Tastrad (16) angewendete Kraft erfasst.

9. Landwirtschaftliche Vorrichtung nach Anspruch 4, 5, 6, 7 oder 8, wobei der zweite Sensor (54) wenigstens teilweise hinter einem Paar furchenziehender Scheiben (14) positioniert ist.

10. Landwirtschaftliche Vorrichtung nach Anspruch 1, wobei das Vorspannelement (32) eine Feder ist und ein erstes Ende, das mit dem ersten Arm (20) gekoppelt ist, und ein zweites Ende, das mit dem Stellantrieb (26) gekoppelt ist, enthält.

11. Reiheneinheiteinstellsystem zur Verwendung mit einer landwirtschaftlichen Pflanzmaschine zum Säen von Saatgut, wobei die landwirtschaftliche Pflanzmaschine (36) einen Geräteträger enthält, wobei eine Reiheneinheit (10) durch eine Verbindung (18) mit dem Geräteträger gekoppelt ist, wobei das Rei-

heneinheiteinstellsystem aufweist:

einen Stellantrieb (26) mit einem Einstellelement;
ein Vorspannelement (32), das mit der Verbindung (18) und dem Einstellelement gekoppelt ist,
wobei das System ferner enthält:

mehrere Sensoren (52, 54), die jeweils zum Erfassen einer separaten Eigenschaft, die mit dem Säen von Saatgut assoziiert sind, und zum Erzeugen eines Signals, das mit jeder der erfassten Eigenschaften assoziiert ist, geeignet sind; und
eine Verarbeitungseinheit (44), welche die mit den erfassten Eigenschaften assoziierten Signale empfängt und auf Basis der Signale bestimmt, ob eine Einstellung des Vorspannelements (32) notwendig ist;
dadurch gekennzeichnet, dass die Eigenschaften die folgenden sind:

eine Stellung des Vorspannelements und das mit der Stellung des Vorspannelements assoziierte Signal;
eine Eigenschaft eines Bodens, auf dem die landwirtschaftliche Pflanzmaschine fährt; und
eine auf die Reiheneinheit angewendete Kraft.

12. Reiheneinheiteinstellsystem nach Anspruch 11, wobei die Eigenschaft des Bodens eine der folgenden ist: Bodentemperatur, Feuchtigkeitsgehalt des Bodens, Tiefe einer Furche und Bodenart.

13. Verfahren zum Einstellen einer auf eine Reiheneinheit (10) einer landwirtschaftlichen Pflanzmaschine (36) angewendeten Kraft, wobei die landwirtschaftliche Pflanzmaschine (36) einen Geräteträger enthält und die Reiheneinheit (10) eine Verbindung (18) enthält, welche die Reiheneinheit (10) mit der landwirtschaftlichen Pflanzmaschine (36) koppelt, wobei das Verfahren aufweist:

Bereitstellen eines Stellantriebs (26) mit einem Einstellelement;
Koppeln eines Vorspannelements (32) an einem ersten Ende mit der Verbindung (18) und an einem zweiten Ende mit dem Einstellelement;
Erfassen mehrere Eigenschaften, die mit dem Säen assoziiert sind, mit mehreren Sensoren (52, 54);
Erzeugen eines mit jeder der Eigenschaften assoziierten Signals mit den Sensoren (52, 54);
Übermitteln der Signale an eine Verarbeitungseinheit (44) und
Einstellen einer Stellung des Vorspannelements (32) mit dem Stellantrieb (26) auf Basis der von der Verarbeitungseinheit (44) empfangenen Signale, um eine auf die Reiheneinheit (10) angewendete Kraft einzustellen;
dadurch gekennzeichnet, dass das Erfassen mehrerer Eigenschaften das Erfassen einer Stellung des Vorspannelements, einer Eigenschaft eines Bodens, auf dem die landwirtschaftliche Pflanzmaschine fährt, und einer auf die Reiheneinheit angewendeten Kraft enthält.

14. Verfahren nach Anspruch 13, wobei das Einstellen einer Stellung des Vorspannelements (32) ferner enthält:

manuelles Einstellen einer Stellung des Vorspannelements (32) nach Anzeigen von mit dem Signal assoziierten Informationen an einer Benutzerschnittstelle (40), oder
automatisches Einstellen einer Stellung des Vorspannelements (32) mit der Verarbeitungseinheit (44) auf Basis des von der Verarbeitungseinheit (44) empfangenen Signals.

Revendications

1. Dispositif agricole (36) comprenant :

une barre d'outils ;
un rayonneur (10) ;
une tringle (18) couplant le rayonneur à la barre d'outils, la tringle (18) incluant un premier bras (20) et un deuxième bras (22), et chaque bras parmi le premier bras (20) et le deuxième bras (22) incluant une première extrémité couplée à la barre d'outils et une deuxième extrémité couplée au rayonneur (10),
cas dans lequel le dispositif agricole (36) inclut un système d'ajustement de rayonneur comprenant
un actionneur (26) couplé à la barre d'outils ;
un élément de sollicitation (32) couplé à la tringle (18) et à l'actionneur (26), l'actionneur (26) étant conçu pour faire bouger l'élément de sollicitation (32) afin de varier une ampleur de force appliquée au rayonneur (10) ;
caractérisé en ce que le dispositif agricole (36) inclut en outre un premier capteur (52) conçu pour détecter une force appliquée au rayonneur (10); et
un deuxième capteur (54) conçu pour détecter une caractéristique d'un sol sur lequel le rayonneur (10) se déplace ; cas dans lequel les premier et deuxième capteurs génèrent un signal associé à la caractéristique qu'ils détectent et

communiquent avec l'unité de traitement de sorte que l'unité de traitement puisse recevoir les signaux, interpréter les signaux, et réagir pour ajuster la force appliquée au rayonneur sur la base des signaux.

2. Dispositif agricole de la revendication 1, l'actionneur (26) faisant bouger l'élément de sollicitation (32) dans un premier sens afin d'appliquer une force vers le bas au rayonneur (10) et faisant bouger l'élément de sollicitation (32) dans un deuxième sens afin d'appliquer une force vers le haut au rayonneur (10), et cas dans lequel les premier et deuxième sens étant des sens différents.

3. Dispositif agricole de la revendication 1, l'actionneur (26) étant l'un des postes suivants :

un actionneur électrique ;
un actionneur hydraulique ;
un actionneur pneumatique ; et
un actionneur à entraînement à vis.

4. Dispositif agricole de la revendication 1, comprenant en outre un troisième capteur (34) conçu pour détecter une position de l'élément de sollicitation (32).

5. Dispositif agricole de la revendication 4 :

le troisième capteur (34) générant un signal associé à la position de l'élément de sollicitation (32), et le dispositif agricole (36) comprenant en outre une unité de traitement (44) en communication avec le troisième capteur (34) afin de recevoir le signal et de déterminer si l'ajustement de l'élément de sollicitation (32) est nécessaire sur la base du signal ;
le premier capteur (52) générant un signal associé à la force appliquée au rayonneur (10), et le dispositif agricole (36) comprenant en outre une unité de traitement (44) en communication avec le premier capteur (52) afin de recevoir le signal et de déterminer si un ajustement de l'élément de sollicitation (32) est nécessaire sur la base du signal ; ou
le deuxième capteur (54) générant un signal associé à la caractéristique du sol, et le dispositif agricole (36) comprenant en outre une unité de traitement (44) en communication avec le deuxième capteur (54) afin de recevoir le signal et de déterminer si l'ajustement de l'élément de sollicitation (32) est nécessaire sur la base du signal.

6. Dispositif agricole de la revendication 5, comprenant en outre une interface d'utilisateur (40) en communication avec l'unité de traitement (44), et tout ajustement nécessaire requis étant communiqué à l'interface d'utilisateur (40) par l'unité de traitement (44) et étant affiché sur l'interface d'utilisateur (40).

7. Dispositif agricole de la revendication 5, l'unité de traitement communiquant avec l'actionneur (26) afin d'ajuster l'élément de sollicitation (32) sur la base du signal.

8. Dispositif agricole de la revendication 5, comprenant en outre une roue de jauge (16), et le premier capteur (52) détectant une force appliquée à une roue de jauge (16).

9. Dispositif agricole de la revendication 4, 5, 6, 7 ou 8, le deuxième capteur (54) étant positionné au moins partiellement derrière une paire de disques d'ouverture de sillons (14).

10. Dispositif agricole de la revendication 1, l'élément de sollicitation (32) étant un ressort et incluant une première extrémité couplée au premier bras (20) et une deuxième extrémité couplée à l'actionneur (26).

11. Système d'ajustement de rayonneur destiné à une utilisation avec une planteuse agricole pour planter des semences, la planteuse agricole (36) incluant une barre d'outils, un rayonneur (10) couplé à la barre d'outils par une tringle (18), le système d'ajustement de rayonneur comprenant :

un actionneur (26) incluant un élément d'ajustement ;
un élément de sollicitation (32) couplé à la tringle (18) et à l'élément d'ajustement ;
cas dans lequel le système inclut en outre
une pluralité de capteurs (52, 54), chacun étant conçu pour détecter une caractéristique séparée associée au plantage de semences et pour générer un signal associé à chacune des caractéristiques détectées ; et
une unité de traitement (44) laquelle reçoit les signaux associés aux caractéristiques détectées et qui détermine si l'ajustement de l'élément de sollicitation (32) est nécessaire sur la base des signaux ;
caractérisé en ce que les caractéristiques sont les suivantes :

une position de l'élément de sollicitation et le signal est associé à la position de l'élément de sollicitation ;
une caractéristique d'un sol sur lequel la planteuse agricole se déplace ; et
une force appliquée au rayonneur.

12. Système d'ajustement de rayonneur de la revendication 11, la caractéristique du sol étant un élément parmi la température du sol, la teneur en humidité

du sol, la profondeur d'un sillon, et le type de sol.

13. Procédé d'ajustement d'une force appliquée à un rayonneur (10) d'une planteuse agricole (36), la planteuse agricole (36) incluant une barre d'outils et le rayonneur (10) incluant une tringle (18) laquelle couple le rayonneur (10) à la planteuse agricole (36), le procédé comprenant les opérations consistant à :

mettre à disposition un actionneur (26) incluant un élément d'ajustement ;
coupler un élément de sollicitation (32) au niveau d'une première extrémité à la tringle (18) et au niveau d'une deuxième extrémité à l'élément d'ajustement ;
détecter une pluralité de caractéristiques associées au plantage à l'aide d'une pluralité de capteurs (52, 54) ;
générer un signal associé à chacune des caractéristiques à l'aide des capteurs (52, 54) ;
communiquer les signaux à une unité de traitement (44) ; et
ajuster une position de l'élément de sollicitation (32) à l'aide de l'actionneur (26) sur la base des signaux reçus par l'unité de traitement (44) dans le but d'ajuster une force appliquée au rayonneur (10) ;
caractérisé en ce que la détection d'une pluralité de caractéristiques inclut la détection d'une position de l'élément de sollicitation, une caractéristique d'un sol sur lequel la planteuse agricole se déplace, et une force appliquée au rayonneur.

14. Procédé de la revendication 13, l'ajustement d'une position de l'élément de sollicitation (32) incluant en outre les opérations consistant à :

ajuster manuellement une position de l'élément de sollicitation (32) après l'affichage d'informations associées au signal sur une interface d'utilisateur (40) ; ou
ajuster automatiquement une position de l'élément de sollicitation (32) à l'aide de l'unité de traitement (44) sur la base du signal reçu par l'unité de traitement (44).

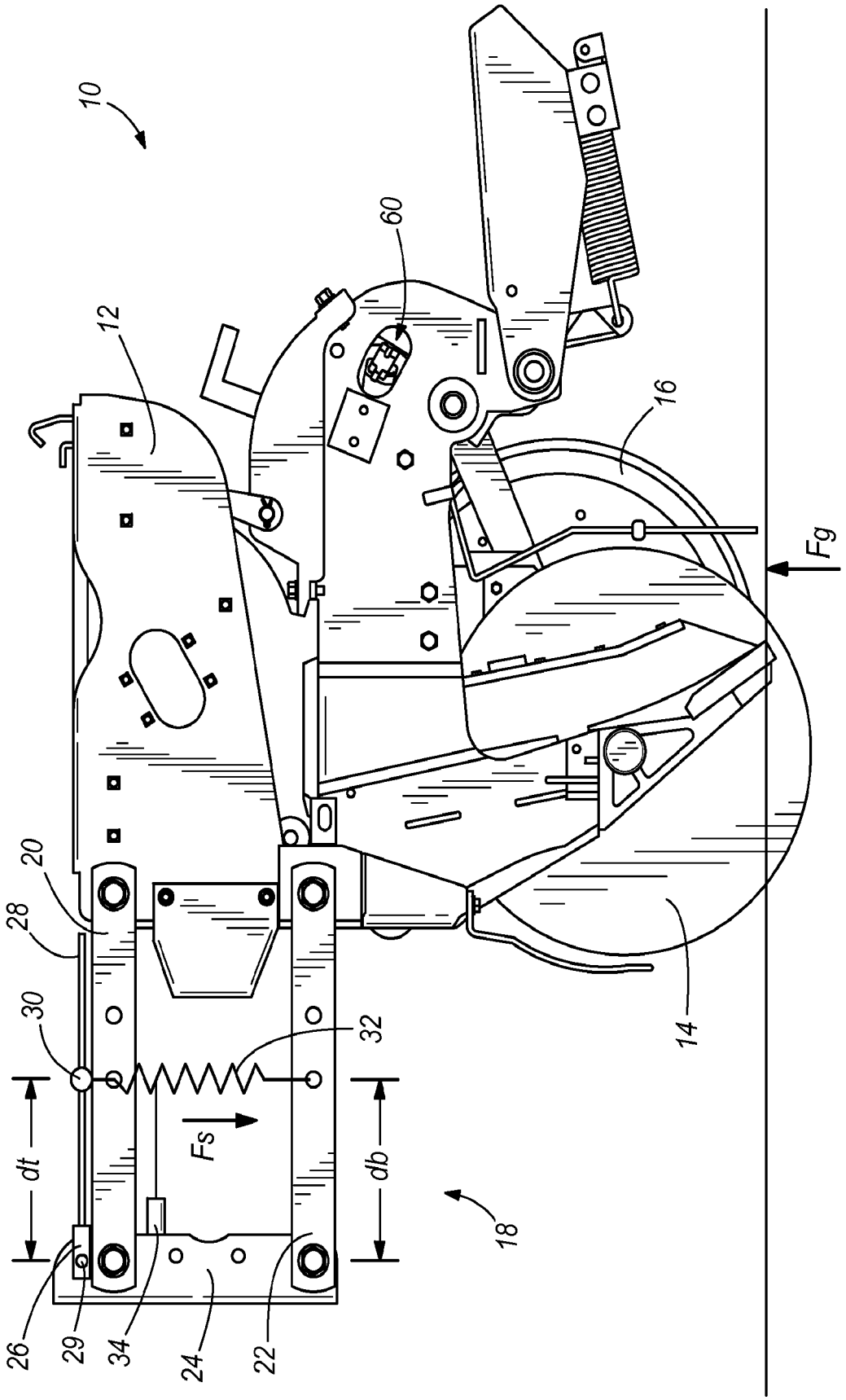

FIG. 1

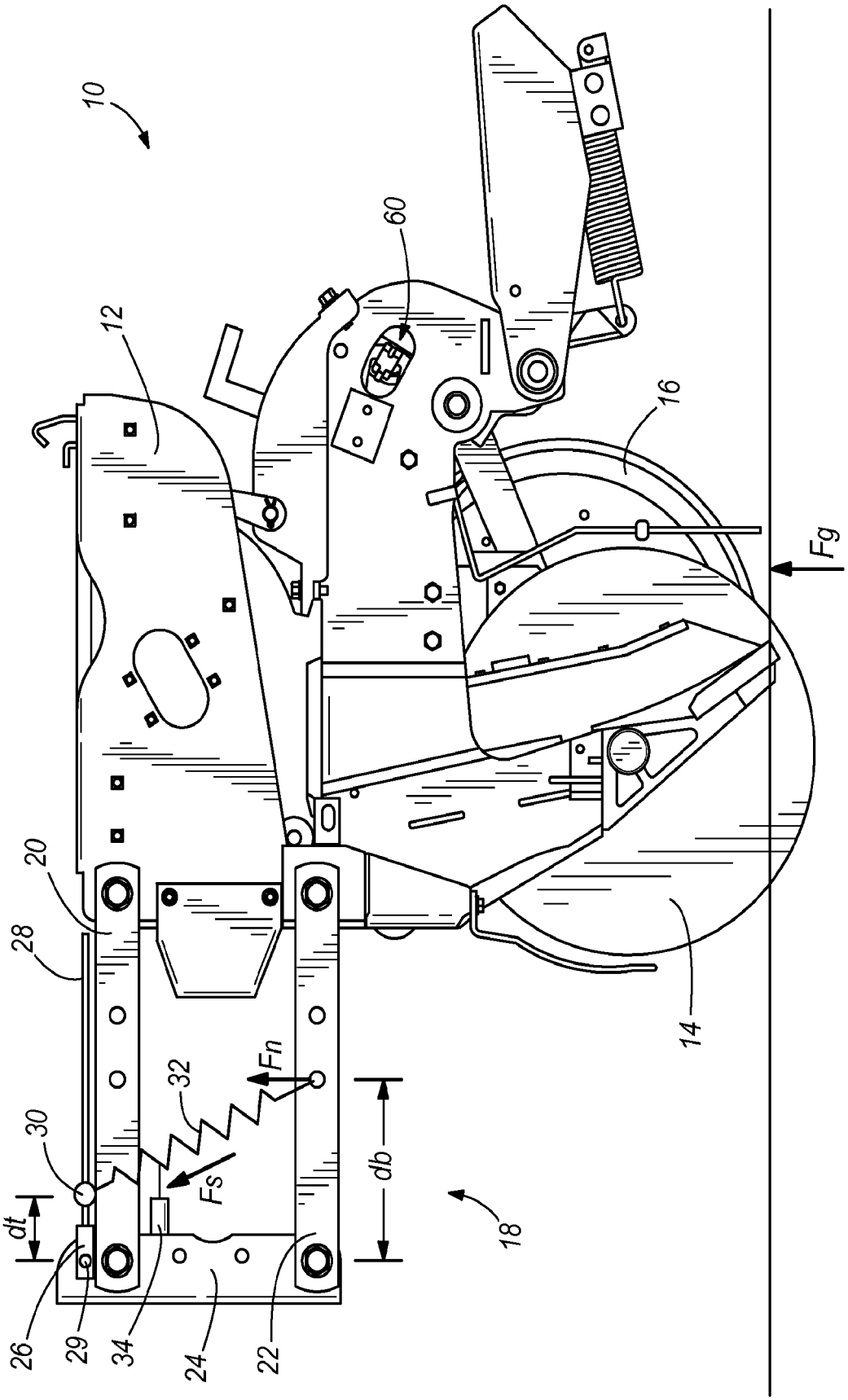

FIG. 2

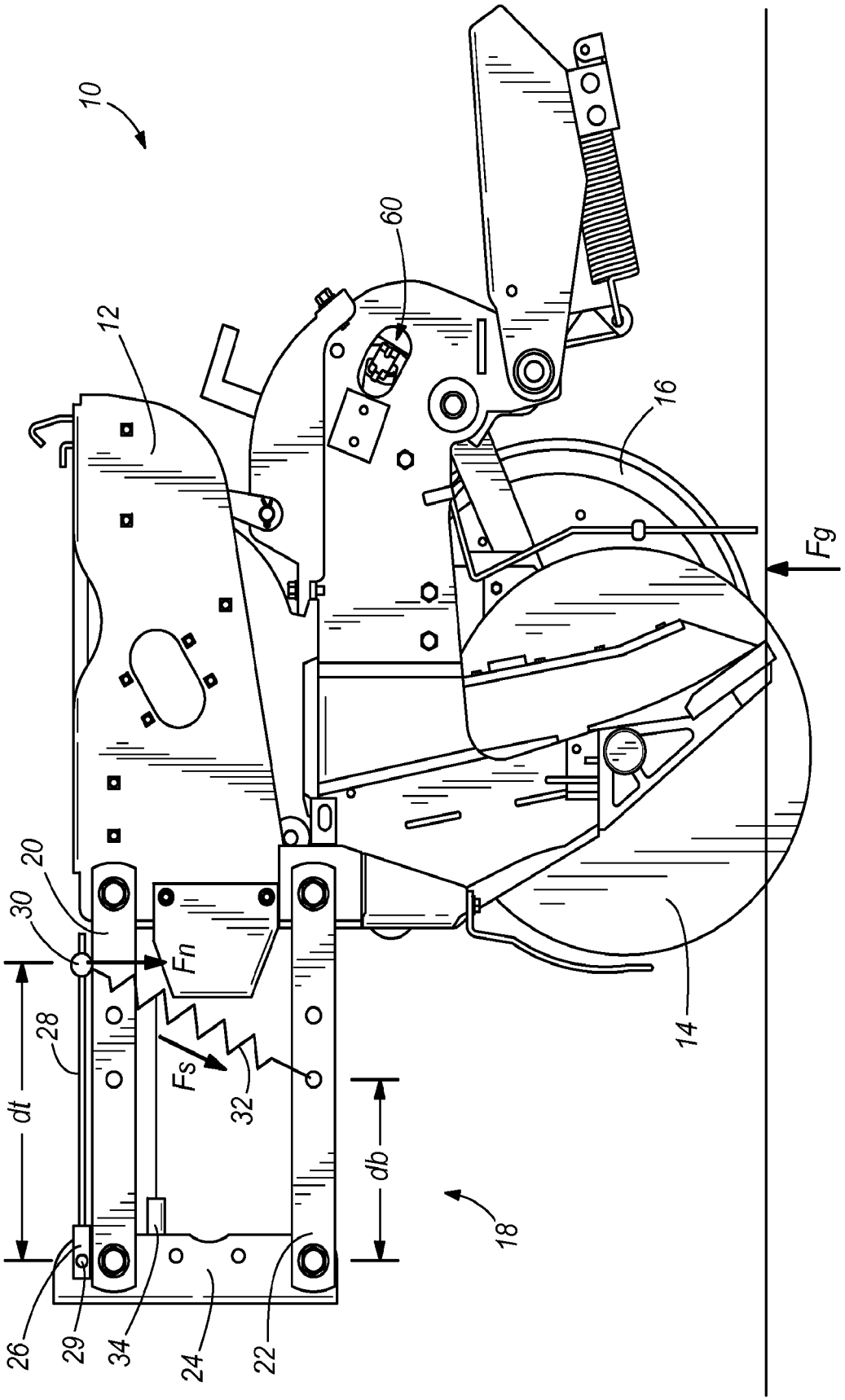

FIG. 3

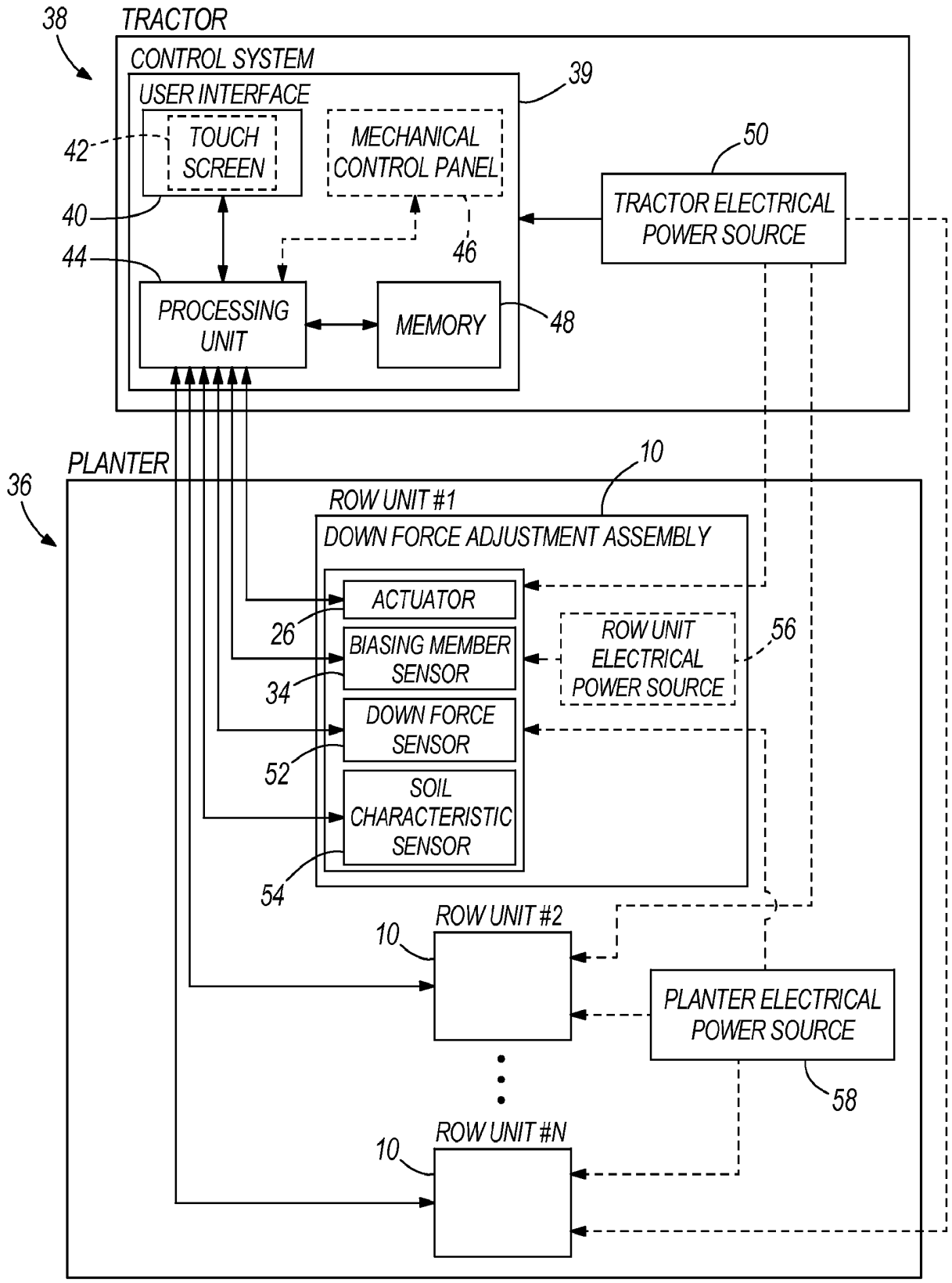
38
TRACTOR
CONTROL SYSTEM
USER INTERFACE
39
42
TOUCH SCREEN
MECHANICAL CONTROL PANEL
50
TRACTOR ELECTRICAL POWER SOURCE
40
44
46
PROCESSING UNIT
MEMORY
48
PLANTER
36
10
ROW UNIT #1
DOWN FORCE ADJUSTMENT ASSEMBLY
ACTUATOR
26
BIASING MEMBER SENSOR
ROW UNIT ELECTRICAL POWER SOURCE
56
34
DOWN FORCE SENSOR
52
SOIL CHARACTERISTIC SENSOR
54
ROW UNIT #2
10
PLANTER ELECTRICAL POWER SOURCE
58
ROW UNIT #N
10

FIG. 4

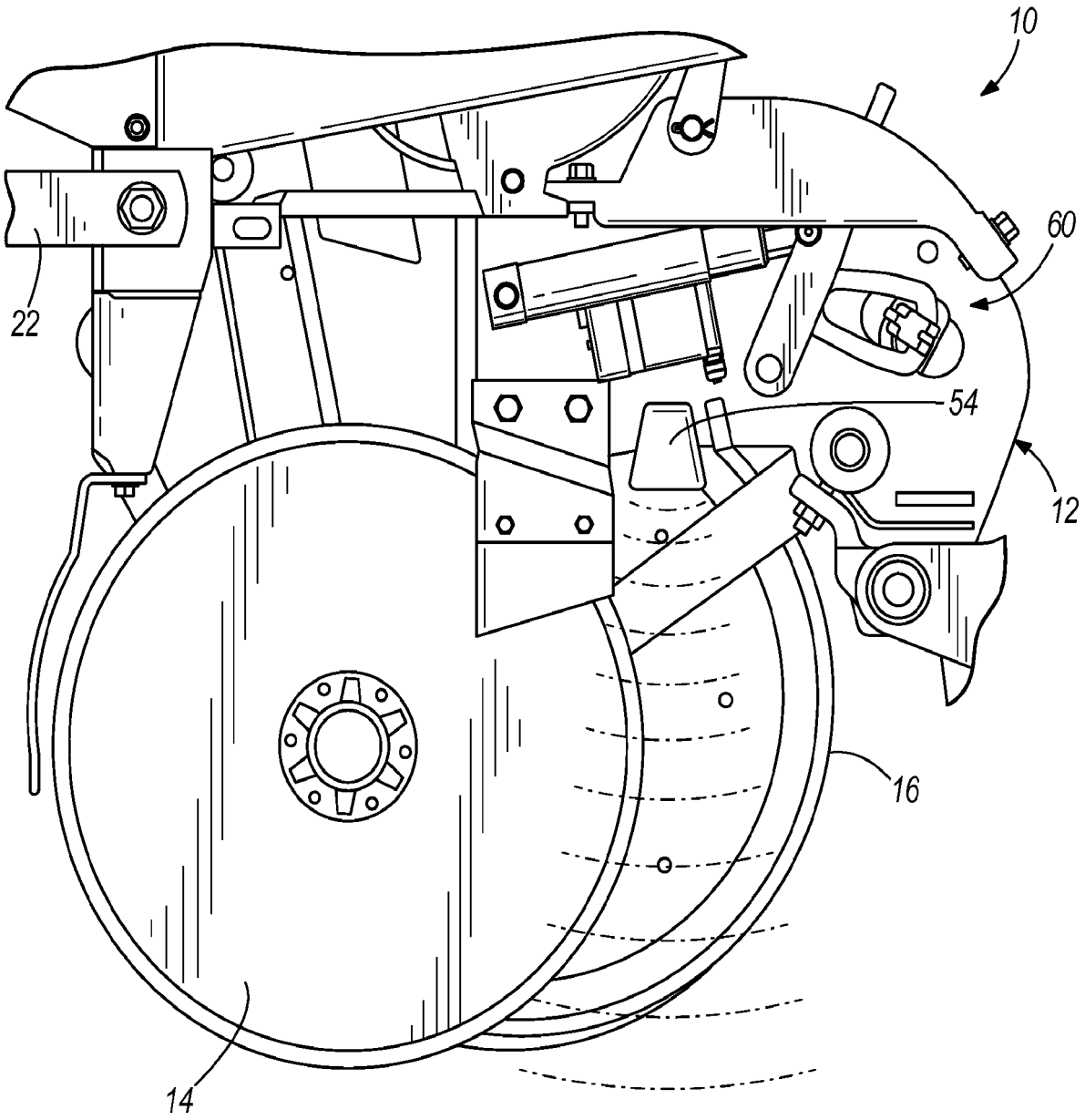

FIG. 5

REFERENCES CITED IN THE DESCRIPTION

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