United States Patent	12382860
Kind Code	B2
Date of Patent	August 12, 2025
Inventor(s)	Leman; Tracy et al.

Implements and application units having at least one application member for placement of applications with respect to agricultural plants of agricultural fields

Abstract

Implements and applicators provide for placement of fluid applications with respect to agricultural plants of agricultural fields. In one embodiment, a fluid applicator for applying fluids to plants in rows in a field includes a base disposed between adjacent rows of plants, and at least one application member connected to the base and disposed to apply fluid to a rhizosphere of a row of the plants.

Inventors: **Leman; Tracy (Eureka, IL), Stoller; Jason J. (Eureka, IL), Radtke; Ian (Washington, IL), Wildermuth; Paul (Tremont, IL)**

Applicant: **Precision Planting LLC** (Tremont, IL)

Family ID: **1000008748680**

Assignee: **Precision Planting LLC (Tremont, IL)**

Appl. No.: **18/059610**

Filed: **November 29, 2022**

Prior Publication Data

Document Identifier	Publication Date
US 20230086491 A1	Mar. 23, 2023

Related U.S. Application Data

continuation parent-doc US 16094155 US 11516962 WO PCT/US2017/028188 20170418 child-doc US 18059610
us-provisional-application US 62442895 20170105

us-provisional-application US 62365824 20160722
us-provisional-application US 62324095 20160418

Publication Classification

Int. Cl.: **A01M7/00** (20060101); **A01B49/06** (20060101); **A01C5/06** (20060101); **A01C21/00** (20060101); **A01C23/00** (20060101); **A01C23/02** (20060101); **A01C23/04** (20060101); **A01M21/04** (20060101); **B05B1/16** (20060101); **B05B1/20** (20060101); A01B79/00 (20060101); A01C7/06 (20060101)

U.S. Cl.:

CPC **A01C23/047** (20130101); **A01B49/06** (20130101); **A01C5/064** (20130101); **A01C5/066** (20130101); **A01C21/002** (20130101); **A01C23/006** (20130101); **A01C23/007** (20130101); **A01C23/023** (20130101); **A01C23/025** (20130101); **A01M7/00** (20130101); **A01M7/0014** (20130101); **A01M7/0042** (20130101); **A01M7/005** (20130101); **A01M7/006** (20130101); **A01M7/0075** (20130101); **A01M7/0089** (20130101); **A01M21/043** (20130101); **B05B1/1636** (20130101); **B05B1/20** (20130101); A01B79/005 (20130101); A01C7/06 (20130101)

Field of Classification Search

CPC: A01M (7/00); A01M (7/0042); A01M (7/005); A01M (21/00); A01M (21/043); A01C (23/00); A01C (23/02); A01C (21/00); A01C (21/002); A01C (23/028); A01C (23/047); A01G (7/06)

References Cited

U.S. PATENT DOCUMENTS

Patent No.	Issued Date	Patentee Name	U.S. Cl.	CPC
3016653	12/1961	Gardner	47/1.7	A01M 7/005
RE26166	12/1966	Inhofer	N/A	N/A
3435785	12/1968	Harbolt	239/159	A01C 23/028
3515349	12/1969	Mecklin et al.	N/A	N/A
4009666	12/1976	Russell	239/281	A01M 7/006
4709505	12/1986	Lempa, Jr.	47/1.7	A01M 7/006
4844346	12/1988	Coffey	239/166	A01M 7/0042
5326030	12/1993	Benest	239/164	A01M 7/0014
5613635	12/1996	Harden	47/1.7	A01M 7/005
5842307	12/1997	May	N/A	N/A
8844451	12/2013	Paton et al.	N/A	N/A
10004175	12/2017	Miller	N/A	A01C 21/002
10159178	12/2017	Muff	N/A	N/A
11432460	12/2021	Stoller	N/A	A01M 7/0089
11558997	12/2022	Stoller	N/A	B05B 1/1636
11985915	12/2023	Stoller	N/A	A01B 49/06
2012/0260836	12/2011	Roth et al.	N/A	N/A

FOREIGN PATENT DOCUMENTS

Patent No.	Application Date	Country	CPC
2381109	12/1999	CN	N/A
2563970	12/1984	FR	N/A
2615693	12/1987	FR	N/A

Primary Examiner: Torres; Alicia

Background/Summary

CROSS REFERENCE TO RELATED APPLICATIONS (1) This application is a divisional application of U.S. application Ser. No. 16/094,155, filed 16 Oct. 2018, which is a national stage entry of PCT Application No. PCT/US2017/028188, filed 18 Apr. 2017, which claims the benefit of U.S. Provisional Application No. 62/324,095, filed on Apr. 18, 2016 entitled: IMPLEMENTS AND APPLICATION UNITS FOR PLACEMENT OF APPLICATIONS WITH RESPECT TO AGRICULTURAL PLANTS OF AGRICULTURAL FIELDS; U.S. Provisional Application No. 62/365,824, filed on Jul. 22, 2016 entitled: IMPLEMENTS AND APPLICATION UNITS FOR PLACEMENT OF APPLICATIONS WITH RESPECT TO AGRICULTURAL PLANTS OF AGRICULTURAL FIELDS; U.S. Provisional Application No. 62/442,895, filed on Jan. 5, 2017 entitled: IMPLEMENTS AND APPLICATION UNITS FOR PLACEMENT OF APPLICATIONS WITH RESPECT TO AGRICULTURAL PLANTS OF AGRICULTURAL FIELDS, the entire contents of which are hereby incorporated by reference.

TECHNICAL FIELD
(1) Embodiments of the present disclosure relate to implements, application units, and fluid applicators having at least one application member for placement of fluid applications with respect to agricultural plants of agricultural fields.
BACKGROUND
(2) Planters are used for planting seeds of crops (e.g., corn, soybeans) in a field. Planters may also be used for applying a fluid application (e.g., fertilizers, chemicals) to the soil or crops. Other fluid applicators include sprayers and sidedress bars. Applying the fluid application between rows can be challenging in terms of controlling this application for the different row units.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
(1) The present disclosure is illustrated by way of example, and not by way of limitation, in the figures of the accompanying drawings and in which:
(2) FIG. **1** shows an example of a system for performing agricultural operations of agricultural fields including operations of an implement having application units in accordance with one embodiment.
(3) FIG. **2** illustrates an architecture of an implement **200** for delivering applications (e.g., fluid applications, fluid mixture applications) to agricultural fields in accordance with one embodiment.
(4) FIG. **3**A illustrates a rear view of an application unit **300** (e.g., a fluid application unit) **300** for applying an application to plants P-**1**, P-**2** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment.
(5) FIG. **3**B illustrates a top view of an application unit **300** (e.g., a fluid application unit) **300** for applying an application to plants P-**1**, P-**2** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment.

(6) FIG. **4** illustrates an embodiment (rear view **402**) of an application unit **400** (e.g., fluid application unit **400**).
(7) FIG. **5** illustrates an embodiment (rear view **502**) of an application unit **500** (e.g., fluid application unit **500**).
(8) FIGS. **6**A and **6**B illustrate another embodiment of a fluid application unit **600**.
(9) FIG. **7** illustrates another embodiment of a fluid application unit **700**.
(10) FIG. **8**A illustrates an embodiment of a fluid application unit **800**.
(11) FIG. **8**B illustrates an embodiment of a fluid application unit **850**.
(12) FIG. **9**A illustrates a top view **902** of an application unit **900** (e.g., a fluid application unit) **900** for applying an application to plants P-**9**, P-**10** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment.
(13) FIG. **9**B illustrates a top view **904** in which the linkage members **920***a*, **920***b* are biased in a non-centered position between rows of plants in accordance with one embodiment.
(14) FIG. **9**C illustrates a side view **940** of the application unit **900** in accordance with one embodiment.
(15) FIG. **9**D illustrates a top view **952** of application units **950**, **980** (e.g., a fluid application unit) for applying an application to plants P-**9**, P-**10** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment.
(16) FIG. **10** illustrates a side view of an application unit **1000** in accordance with one embodiment.
(17) FIG. **11** illustrates a rear view **1102** of an application unit **1100** in accordance with one embodiment.
(18) FIG. **12** shows an example of a system **1200** that includes a machine **1202** (e.g., tractor, combine harvester, etc.) and an implement **1240** (e.g., planter, cultivator, plough, sprayer, spreader, irrigation implement, etc.) in accordance with one embodiment.
(19) FIG. **13**A (side view) illustrates an embodiment of a fluid application unit **1300**.
(20) FIG. **13**B (top view) illustrates an embodiment of a liquid application unit **1350** having multiple trench forming members (e.g., knives) and fluid outlets.
(21) FIG. **14** illustrates an adjustable bracket **1400** for coupling any of the frames described herein to a bar **10** in accordance with one embodiment.
(22) FIG. **15**A illustrates an isometric view of an application unit **1500** in accordance with one embodiment.
(23) FIG. **15**B illustrates an isometric view of a fluid biasing system for use with application unit **1532** in accordance with one embodiment.
(24) FIG. **16** illustrates an isometric view of an application unit **1600** positioned in proximity to rows of plants in accordance with one embodiment.
(25) FIG. **17**A illustrates an isometric view of an application unit **1700** in accordance with one embodiment.
(26) FIG. **17**B illustrates an isometric view of an application unit **1750** in accordance with one embodiment.
(27) FIG. **17**C illustrates a side view of an application unit **1752** in accordance with one embodiment.
(28) FIG. **17**D illustrates an isometric view of an application unit **1780** in accordance with another embodiment.
(29) FIG. **18**A illustrates an isometric view of a solenoid actuated system for use with application unit **1700** in accordance with one embodiment.
(30) FIG. **18**B illustrates an isometric view of a motor actuated system for use with application unit **1700** in accordance with one embodiment.
(31) FIG. **19**A illustrates an isometric view of a linkage system actuated with a solenoid for use with application unit **1700** in accordance with one embodiment.

(32) FIG. **19**B illustrates an isometric view of a linkage system actuated with a motor for use with application unit **1700** in accordance with one embodiment.
(33) FIG. **19**C illustrates an isometric view of a linkage system actuated with a ground contacting arm for use with application unit **1700** in accordance with one embodiment.
(34) FIG. **20**A is a side elevation view of a closer on a coulter wheel according to one embodiment.
(35) FIG. **20**B is a rear view of the closer of FIG. **20**A according to one embodiment in which the top and bottom of the arms are equidistant to the axis through the trench and the front and back of the arms are equidistant to the axis through the trench.
(36) FIG. **20**C is a rear view of the closer of FIG. **20**A according to one embodiment in which the bottom of the arms are closer to the axis through the trench than the top of the arms.
(37) FIG. **20**D is a rear view of the closer of FIG. **20**A according to one embodiment in which the back of the arms are closer to the axis through the trench than the front of the arms.
(38) FIG. **20**E is a rear view of the closer of FIG. **20**A according to one embodiment in which the bottom of the arms are closer to the axis through the trench than the top of the arms and the back of the arms are closer to the axis through the trench than the front of the arms.
(39) FIG. **20**F is a side view of the closer of FIG. **20**B according to one embodiment in which the bottom of the arm is at least partially disposed behind the top of the arm in a direction of travel.
(40) FIG. **21**A is a side elevation view of an alternative closer disposed on a blade according to one embodiment.
(41) FIG. **21**B is a rear elevation view of the blade and closer of FIG. **21**A.
(42) FIG. **22**A is a side elevation view of an alternative nozzle having a biasing ski according to one embodiment.
(43) FIG. **22**B is a bottom view of the nozzle of FIG. **22**A with the biasing ski removed for clarity.
(44) FIG. **23** is a top view of a flexible member having a reinforcement disposed thereon according to one embodiment.
(45) FIG. **24**A is a side elevation view of a cradle disposed on a bracket according to one embodiment.
(46) FIG. **24**B is a rear elevation view of the cradle of FIG. **24**A.
(47) FIG. **25** is an alternative embodiment of an application unit **3200** according to one embodiment.
(48) FIG. **26** is an alternative embodiment for a spring disposed over a flexible member.
(49) FIG. **27**A illustrates a side elevation view of an application unit **2700** according to one embodiment.
(50) FIG. **27**B is a top plan view of the embodiment of FIG. **27**A.
(51) FIG. **27**C is a rear elevation view of the embodiment of FIG. **27**A traversing a field with plants in rows.
(52) FIG. **27**D is a partial perspective view from the bottom of the embodiment of FIG. **27**A with some components removed for clarity.
(53) FIG. **27**E is a partial perspective view of the embodiment of FIG. **27**A with some components removed for clarity.
(54) FIG. **27**F is a partial bottom view of the embodiment of FIG. **27**A with an optional stop with some components removed for clarity.
(55) FIG. **27**G is a partial top view of the embodiment of FIG. **27**A showing optional bias element **2748**.
(56) FIG. **28**A is a top view of an application unit with a damper according to one embodiment.
(57) FIG. **28**B is a top view of an application unit with a damper according to one embodiment.
(58) FIG. **28**C is a top view of an application unit with a damper according to one embodiment.
(59) FIG. **28**D is a top view of an application unit with a damper according to one embodiment.

SUMMARY

(60) Described herein are systems, implements, and application units having mechanisms for

placement of applications to agricultural plants of agricultural fields. In one embodiment, an application unit includes a frame to be positioned in operation between two rows of plants and a first plurality of flexible members coupled to the frame in operation such that the first plurality of flexible members guide a lateral position of the frame to be approximately equidistant from the two rows of plants based upon whether at least one flexible member of the first plurality of flexible members contacts one or more plants of the two rows of plants. The first plurality of flexible members include a plurality of fluid outlets for spraying crop input in close proximity to the rows of plants. In one example, the application unit also includes a second plurality of flexible members for guiding a lateral position of a base member that is coupled to the frame.

(61) In one embodiment, an application unit comprising: a frame to be positioned in operation between first and second rows of plants; a first plant contacting member being pivotally coupled to the frame in operation such that the first plant contacting member to be deflected rearwardly with respect to a direction of motion of the frame upon the first plant contacting member contacting at least one of the plants of the first row of plants which causes a first change in orientation of the first plant contacting member with respect to the frame; and a first outlet for applying a liquid application to the first row of plants with the first outlet being mechanically linked to the first plant contacting member, wherein the first change in orientation causes a corresponding second change in orientation of the first outlet with respect to the frame.

(62) In one embodiment, an application unit comprising: a frame to be positioned in operation between two rows of plants; a base member coupled to the frame, the base member to be positioned in proximity to a ground surface while in operation; and first and second plant guidance members coupled to the base member in operation such that the first and second plant guidance members guide a lateral position of the base member to be approximately equidistant from the two rows of plants based upon whether at least one of the first and second plant guidance members contacts one or more plants of the two rows of plants.

(63) In one embodiment, an application unit comprising: a frame to be positioned in operation between two rows of plants; a base member coupled to the frame; and at least one linkage member for conveying fluid coupled to a biasing element of the base member in operation such that the biasing element biases an angular position of the at least one linkage member.

(64) An application unit comprising: a frame to be positioned in operation between two rows of plants; and a first plurality of flexible members coupled to the frame in operation such that the first plurality of flexible members guide a lateral position of the frame to be approximately equidistant from the two rows of plants based upon whether at least one of the first plurality of flexible members contacts one or more plants of the two rows of plants.

(65) In one embodiment, a fluid applicator for applying fluid to plants in rows in a field comprising: at least one applicator arm that is actuated by an actuator to move the applicator arm from a position in the row between plants to a position adjacent to the plant.

(66) In one embodiment, a fluid applicator for applying fluids to plants in rows in a field comprising: a base, at least one flexible or pivoting application member connected to the base and disposed to apply fluid to the plants, and a stabilizer associated with the at least one flexible or pivoting application member, wherein the stabilizer comprises at least one of:

(67) a) a spring disposed over the at least one flexible application member,

(68) b) a reinforcement that is disposed on or in the at least one application member and disposed along a length of the at least one application member,

(69) c) a wire attached to the at least one application member, the wire having a length to contact at least one plant, and

(70) d) a damper.

(71) In one embodiment, a fluid applicator for applying fluids to plants in rows in a field comprising: a frame; a coulter connected to the frame and disposed to open a trench between the rows of plants; at least one application member connected to the frame or to the coulter and

disposed to apply fluid to a rhizosphere of the plants.
(72) In one embodiment, a fluid applicator for applying fluids to plants in rows in a field comprising: a base disposed between plants in adjacent rows, at least one application member connected to the base and disposed to apply fluid to the plants in a rhizosphere of the plants, and a nozzle disposed at an end of the application member for dispensing fluid from the application member to the plants in the rhizosphere of the plants.
(73) In one embodiment, a trench closer for a fertilizer applicator comprising, a bar moved through a field transverse to a direction of travel, a fertilizer applicator connected to the bar for forming a trench in soil, wherein the fertilizer applicator comprises a coulter, a knife, or a coulter and a knife, and a trench closer disposed behind the fertilizer applicator in the direction of travel and connected to the fertilizer applicator or the bar, wherein the trench closer is not a disk that rolls in a direction of travel.

DETAILED DESCRIPTION

(74) Described herein are systems, implements, and application units having mechanisms for placement of applications to agricultural plants of agricultural fields.
(75) In an embodiment, an application unit includes a frame to be positioned in operation between first and second rows of plants, a first plant contacting member being pivotally coupled to the frame in operation such that the first plant contacting member to be deflected rearwardly with respect to a direction of motion of the frame upon the first plant contacting member contacting at least one of the plants of the first row of plants which causes a first change in orientation of the first plant contacting member with respect to the frame. A first outlet applies a fluid application to the first row of plants. The first change in orientation causes a corresponding second change in orientation of the first outlet with respect to the frame.
(76) Each application unit includes components (e.g., planting contacting members, feelers, guidance members, linkage members, flexible members, etc) for obtaining a proper placement (e.g., orientation and/or positioning) of one or more fluid outlets with respect to rows of plants in an agricultural field. The fluid outlets are then able to precisely apply (spray or dribble) the fluid applications on a desired target region (e.g., rhizosphere, a bottom portion of a plant, root ball, crown, crown root, mesocotyl, below a first node of a plant) of rows of plants to more efficiently spray plants at a lower cost due to less wasted crop input (e.g., nutrients, fertilizer, fungicide, herbicide or insecticide).
(77) In the following description, numerous details are set forth. It will be apparent, however, to one skilled in the art, that embodiments of the present disclosure may be practiced without these specific details. In some instances, well-known structures and devices are shown in block diagram form, rather than in detail, in order to avoid obscuring the present disclosure.
(78) FIG. **1** shows an example of a system **100** for performing agricultural operations (e.g., applying fluid applications to plants) of agricultural fields including operations of an implement having application units in accordance with one embodiment. For example and in one embodiment, the system **100** may be implemented as a cloud based system with servers, data processing devices, computers, etc. Aspects, features, and functionality of the system **100** can be implemented in servers, planters, planter monitors, sprayers, sidedress bars, combines, laptops, tablets, computer terminals, client devices, user devices (e.g., device **190**), handheld computers, personal digital assistants, cellular telephones, cameras, smart phones, mobile phones, computing devices, or a combination of any of these or other data processing devices.
(79) In other embodiments, the system **100** includes a network computer or an embedded processing device within another device (e.g., display device) or within a machine (e.g., planter, combine), or other types of data processing systems having fewer components or perhaps more components than that shown in FIG. **1**. The system **100** (e.g., cloud based system) and agricultural operations can control and monitor fluid applications using an implement or machine. The system **100** includes machines **140**, **142**, **144**, **146** and implements **141**, **143**, **145** coupled to a respective

machine **140**, **142**, **144**, **146**. The implements (or machines) can include flow devices for controlling and monitoring fluid applications (e.g., spraying, fertilization) of crops and soil within associated fields (e.g., fields **102**, **105**, **107**, **109**). The system **100** includes an agricultural analysis system **102** that includes a weather store **150** with current and historical weather data, weather predictions module **152** with weather predictions for different regions, and at least one processing system **132** for executing instructions for controlling and monitoring different operations (e.g., fluid applications). The storage medium **136** may store instructions, software, software programs, etc for execution by the processing system and for performing operations of the agricultural analysis system **102**. In one example, storage medium **136** may contain a fluid application prescription (e.g., fluid application prescription that relates georeferenced positions in the field to application rates). The implement **141** (or any of the implements) may include an implement **200** whose pump, flow sensors and/or flow controllers may be specifically the elements that are in communication with the network **180** for sending control signals or receiving as-applied data.

(80) An image database **160** stores captured images of crops at different growth stages. A data analytics module **130** may perform analytics on agricultural data (e.g., images, weather, field, yield, etc.) to generate crop predictions **162** relating to agricultural operations.

(81) A field information database **134** stores agricultural data (e.g., crop growth stage, soil types, soil characteristics, moisture holding capacity, etc.) for the fields that are being monitored by the system **100**. An agricultural practices information database **135** stores farm practices information (e.g., as-applied planting information, as-applied spraying information, as-applied fertilization information, planting population, applied nutrients (e.g., nitrogen), yield levels, proprietary indices (e.g., ratio of seed population to a soil parameter), etc.) for the fields that are being monitored by the system **100**. An implement can obtain fluid application data from the CMUs and provide this data to the system **100**. A cost/price database **138** stores input cost information (e.g., cost of seed, cost of nutrients (e.g., nitrogen)) and commodity price information (e.g., revenue from crop).

(82) The system **100** shown in FIG. **1** may include a network interface **118** for communicating with other systems or devices such as drone devices, user devices, and machines (e.g., planters, combines) via a network **180** (e.g., Internet, wide area network, WiMax, satellite, cellular, IP network, etc.). The network interface includes one or more types of transceivers for communicating via the network **180**.

(83) The processing system **132** may include one or more microprocessors, processors, a system on a chip (integrated circuit), or one or more microcontrollers. The processing system includes processing logic for executing software instructions of one or more programs. The system **100** includes the storage medium **136** for storing data and programs for execution by the processing system. The storage medium **136** can store, for example, software components such as a software application for controlling and monitoring fluid applications or any other software application. The storage medium **136** can be any known form of a machine readable non-transitory storage medium, such as semiconductor memory (e.g., flash; SRAM; DRAM; etc.) or non-volatile memory, such as hard disks or solid-state drive.

(84) While the storage medium (e.g., machine-accessible non-transitory medium) is shown in an exemplary embodiment to be a single medium, the term “machine-accessible non-transitory medium” should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term “machine-accessible non-transitory medium” shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the present disclosure. The term “machine-accessible non-transitory medium” shall accordingly be taken to include, but not be limited to, solid-state memories, optical and magnetic media, and carrier wave signals. FIG. **2** illustrates an architecture of an implement **200** for delivering applications (e.g., fluid applications, fluid mixture applications) to agricultural fields in accordance

with one embodiment. The implement **200** includes at least one storage tank **250**, flow lines **260** and **261**, a flow controller **252** (e.g., valve), and at least one variable-rate pump **254** (e.g., electric, centrifugal, piston, etc.) for pumping and controlling application rate of a fluid (e.g., fluid application, semifluid mixture) from the at least one storage tank to different application units **210**-**217**, respectively of the implement. At least one flow sensor **270** can be utilized on the implement **200** either row-by-row or upstream of where the fluid branches out to the application units as illustrated in FIG. **2**. The flow controller **252** can be row-by-row as opposed to implement-wide as shown in FIG. **2**.

(85) The applications units are mechanically coupled to the frames **220**-**227** which are mechanically coupled to a bar **10**. Each application unit **210**-**217** can include flow sensors and components having a placement mechanism (e.g., planting contacting members, feelers, guidance members) for obtaining a proper orientation and/or positioning of a fluid outlet with respect to a plant in an agricultural field. The application units can include any of the embodiments described herein in conjunction with FIGS. **3**A, **3**B, **4**-**11**, and **13**A and **13**B.

(86) FIG. **3**A illustrates a rear view of an application unit **300** (e.g., a fluid application unit) **300** for applying an application to plants P-**1**, P-**2** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment. It should be appreciated that the unit **300** is illustrated traveling in a direction D into the page in FIG. **3**A (rear view **302**) and traveling upward in FIG. **3**B (top view **350**) along a direction D. The application unit **300** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. The application unit **300** preferably extends laterally between existing corn plants P-**1**, P-**2** as the bar **10** traverses the field having a ground surface **390**.

(87) Continuing to refer to FIG. **3**A (rear view), the fluid application unit **300** preferably comprises a downwardly-extending frame **310** to which feelers **320***a*, **320***b* and fluid outlets **330***a*, **330***b* are preferably pivotally connected. As shown in FIG. **3**B (top view **350**), the feelers **320** preferably pivot with a range of angular motion **321***a*, **321***b* about an axis parallel to the frame **310**, e.g., a vertical axis. In operation, when the feelers **320***a*, **320***b* contact passing plants (e.g., P-**1**, P-**2**), the feelers **320***a*, **320***b* preferably deflect rearwardly in a downward direction. A spring element (not shown) or other biasing element preferably biases the feelers **320***a*, **320***b* into a neutral position **360***a*, **360***b* to which the feeler preferably returns when not deflected by a plant or other obstacle. A length of the feelers **320***a*, **320***b* may be designed based on a row spacing (e.g., **20**″, **30**″, etc.) with each feeler **320***a*, **320***b* having a length of approximately one half of the row spacing between rows of plants. In one example, the feelers **320***a*, **320***b* may have adjustable lengths depending on the row spacing for a field.

(88) Each feeler **320** is preferably operatively mechanically linked to one of the fluid outlets **330** such that a change in orientation of the feeler **320** relative to the frame **310** changes an orientation of the linked fluid outlet **330**.

(89) In the embodiment of FIG. **3**A (rear view), rearward angular deflection of the feeler **320** (e.g., **320***a*, **320***b*) results in corresponding (e.g., equal) angular deflection with a range of angular motion **331***a*, **331***b* of the fluid outlet **330** (e.g., **330***a*, **330***b*) linked to the feeler. A rigid link **325** (e.g., **325***a*, **325***b*) constrains the fluid outlet **330** to pivot in a synchronized fashion with the feeler **320**. The fluid outlet **330** preferably pivots about an axis which is preferably parallel to the frame **310**. The pivot axis of the fluid outlet **330** is preferably parallel to and preferably substantially aligned with the pivot axis of the feeler **320**. As a result, a spray S (e.g., pressurized spray Sa, Sb) emitted from the fluid outlet **330** (e.g., via orifices **332***a*, **332***b*) preferably disposed at a distal end of the outlet) is preferably oriented toward a plant P-**1**, P-**2** contacted by the feeler **320**.

(90) In another embodiment, the fluid application unit **300** includes a single fluid outlet and a single feeler for spraying a single row of plants. In one example, the application unit **300** includes the feeler **320***a* and the fluid outlet **330***a* for spraying the row of plants P-**1**. The feeler **320***b* and fluid outlet **330***b* are not included in this example. A different application unit is provided for

spraying the plants P-**2**.
(91) In another example, the application unit **300** includes the feeler **320***b* and the fluid outlet **330***b* for spraying the row of plants P-**2**. The feeler **320***a* and fluid outlet **330***a* are not included in this example. A different application unit is provided for spraying the plants P-**1**.
(92) In another embodiment, the fluid application unit **300** includes at least one fluid outlet (e.g., **330***a*, **330***b*) and no feelers **320**, **320***b* and no link **325***a*, **325***b*. The at least fluid outlet is positioned and/or oriented to spray a fluid towards a base region of a plant (e.g., into soil within 3-4 inches of the base region of the plant, towards a region in which a base of the plant emerges from the soil).
(93) It should be appreciated that each fluid outlet in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide). Each fluid outlet described herein provides a pressurized spray (e.g., 1-200 psi, 5-100 psi, etc.) in a direction (e.g., substantially downward direction) towards a base region of a plant (e.g., into soil within 3-4 inches of the base region of the plant, towards a region in which a base of the plant emerges from the soil). In another example, at least one fluid outlet of an application unit provides a dribble of liquid (e.g., non-pressurized source) rather than a pressurized spray.
(94) In the embodiment of an application unit **400** (e.g., fluid application unit **400**) shown in FIG. **4** (rear view **402**), the frame **410** supports a feeler **420** which preferably functions similarly to the unit **300** described above. The frame **410** may be coupled to a bar **10** in a similar manner as the frame **310** is coupled to the bar **10** in FIG. **3**A. As described in more detail herein, rearward deflection (out of the page) of the feeler **420** preferably causes the fluid outlet **430** to deflect in a transverse vertical plane (e.g., generally up and down along the view of FIG. **4** (rear view)). In one example, when a transverse distance between frame **410** and an adjacent plant P-**3** decreases, the feeler is pivoted rearward with respect to a neutral position of the feeler, preferably causing the fluid outlet **430** to pivot downward such that a spray S-**3** emitted by the fluid outlet **430** (e.g., from a fluid orifice **432** preferably disposed at a distal end thereof) is directed more closely toward a bottom portion (e.g., root ball, crown, crown root, mesocotyl) of the plant. Conversely, when a transverse distance between frame **410** and an adjacent plant P-**3** increases, a biasing element (not shown) causes the feeler to pivot forward with respect to a neutral position of the feeler, preferably causing the fluid outlet to pivot upward such that the spray S-**3** is directed more closely toward the bottom portion of the plant or towards soil within 0-4 inches of the bottom portion of the plant.
(95) Referring to the illustrated embodiment of FIG. **4** (rear view) in more detail, the feeler **420** preferably pivots about a central vertical axis of the frame **410**, which is preferably round in cross-section. A link **411** preferably constrains a horizontal gear **415** to rotate about the central vertical axis of the frame **410**. The central vertical axis is substantially perpendicular with respect to a ground surface **490**. The horizontal gear **415** preferably drives a vertical gear **425** (e.g., teeth of gear **415** engage with teeth of gear **425**), which preferably selectively raises or lowers the outlet **430**, e.g., by winding or unwinding a support cable **429** which may be wound around a drive shaft of the vertical gear **425** at an upper end thereof and attached to the outlet **430** at a lower end thereof.
(96) The embodiments described herein may include a pair of feelers each having an associated (e.g., linked) fluid outlet. In other embodiments, the fluid outlets may be constrained (e.g., by a linkage) to pivot at equal and opposite angles, and one of the outlets may be associated with (e.g., linked to) a single feeler.
(97) The feelers **320**, **420** described herein may contact the adjacent plants at any location. In a preferred embodiment, each feeler is preferably disposed to contact an adjacent plant on a stem or stalk thereof; for example, the feeler may be disposed adjacent the ground in order to contact the stalk at a location immediately above the soil (e.g., above the crown and below the lowest node of the plant). In some such embodiments, the fluid outlet may be disposed above the feeler instead of below the feeler as illustrated in FIG. **5** in accordance with one embodiment.

(98) In the embodiment of an application unit **500** (e.g., fluid application unit **500**) shown in FIG. **5** (rear view **502**), the frame **510** supports a feeler **520** which preferably functions similarly to the unit **400** described above. As described in more detail herein, rearward deflection of the feeler **520** preferably causes the fluid outlet **530** to deflect in a transverse vertical plane (e.g., generally up and down along the view of FIG. **5** (rear view)). When a transverse distance between frame **510** and an adjacent plant P-**4** decreases, the feeler **520** is pivoted rearward with respect to a neutral position of the feeler **520**, preferably causing the fluid outlet **530** to pivot downward such that a spray S-**4** emitted by the fluid outlet **530** (e.g., from a fluid orifice **532** preferably disposed at a distal end thereof) is directed more closely toward a bottom portion (e.g., root ball, crown, crown root, mesocotyl) of the plant that is in close proximity to a ground surface **590**. Conversely, when a transverse distance between frame **510** and an adjacent plant P-**4** increases, a biasing element (not shown) causes the feeler to pivot forward with respect to a neutral position of the feeler **520**, preferably causing the fluid outlet **530** to pivot upward such that the spray S-**4** is directed more closely toward the bottom portion of the plant (e.g., within 0-4 inches of the bottom portion of the plant).

(99) In still another embodiment of a fluid application unit **600** illustrated in FIG. **6**A (side view **602**) and FIG. **6**B (top view **604**), a downwardly and preferably rearwardly extending frame **620** (e.g., a flexible, or semi-flexible frame) is fixed to the bar **10** at an upper end thereof by a bracket **610**. A base member **630** supported at a lower end of the frame **620** is preferably disposed adjacent a ground surface **690** and may have a lower curved surface for riding (continuously or discontinuously) along the ground surface. Fluid outlets **640***a*, **640***b* are preferably supported by the base member **630** and are preferably disposed to apply a fluid to the plants P-**5**, P-**6** (e.g., at a lower portion of each plant such as at a crown thereof). The fluid outlets **640***a*, **640***b* may have orifices disposed at a distal end thereof for forming a spray which is preferably directed toward the plants. Guidance members **650***a*, **650***b* preferably guide the lateral position of the base member **630**; e.g., contact between the guidance members **650***a*, **650***b* and stems of plants P-**5**, P-**6** may deflect the frame **620** to allow the base member **630** to remain equidistant from each row of plants P-**5**, P-**6** adjacent to the base member **630**. The guidance members **650** are preferably made of a semi-flexible or semi-rigid material such as spring steel and may include a spring coil **652** for permitting the guidance member **650***a*, **650***b* to deflect when encountering obstacles. The guidance members **650** may include a first portion **655***a*, **656***a* extending outwardly and rearwardly toward the row of plants, a second portion **655***b*, **656***b* extending generally parallel to the row of plants, and a third portion **655***c*, **656***c* extending inwardly and rearwardly away from the row of plants. In one embodiment, all base members adjust their position with respect to the rows of plants.

(100) A width (W) of the guidance members may be designed based on a row spacing (e.g., **20**″, **30**″, etc.) with each guidance member having a length of slightly less than approximately one half of the row spacing between rows of plants. In one example, the guidance members may have adjustable widths depending on the row spacing for a field.

(101) In one example, the application unit **600** includes at least one fluid outlet (e.g., **640***a*, **640***b*) that sprays or dribbles fluid towards a base region of the plants P-**5**, P-**6**. The base member **630** contacts a ground surface **690** in a continuous or non-continuous manner along the ground surface. A flexible frame **620** couples the base member **630** to a bracket **610**. In another embodiment, the application unit **600** does not include guidance members **650***a*, **650***b*. At least one fluid outlet **640***a*, **640***b* sprays the fluid towards a base region of the plants P-**5**, P-**6**.

(102) In another embodiment of a fluid application unit **700** illustrated in FIG. **7** (rear view **702**), a downwardly extending frame **710** is preferably permitted to slide up and down as indicated by arrows **722** relative to the bar **10** but retained to the bar **10** by a collar **720** extending around the frame **710** at an upper end thereof. The unit **700** is preferably functionally similarly to the unit **300** except the unit **700** includes a ground engaging element **712**, a collar **720**, and an internal channel **750** for directing fluid through the frame **710**. A ground-engaging element **712** (e.g., a wheel or ski)

is preferably mounted to a lower end of the frame **710** and disposed to contact the ground during operation such that a fluid outlet **730** retains its position relative to the ground surface **790** in operation. One or more feelers and related linkage mechanisms for reorienting the fluid outlet (as described herein according to various embodiments) may additionally be incorporated in the unit **700**. The frame **710** may include a fluid inlet **740** that is in fluid communication with an internal channel **750** (e.g., formed within the frame and/or disposed within the frame) for directing fluid to the fluid outlet **730**. The fluid outlet **730** may additionally include an internal channel **760** (e.g., formed as a part within fluid outlet **730** and/or disposed within the fluid outlet **730**) for directing fluid to the distal end (e.g., orifice **732**) of the fluid outlet **730**. The channels **750** and **760** are preferably in fluid communication via a flexible conduit (not shown) such as a hose or tube. The fluid inlet **740** may be in fluid communication with a flexible conduit that is in fluid communication with a fluid source (e.g., tank).

(103) Referring to FIG. **8**A (rear view **802**), an embodiment of a fluid application unit **800** is illustrated which is substantially similar to the application unit **300** described herein, except that the frame **810** is coupled to or includes one or more opening discs **811***a*, **811***b* (e.g., vertical coulters, angled opening discs) for opening a trench T in the soil. The frame **810** preferably includes an internal or externally mounted conduit (not shown) for applying a crop input (e.g., fluid crop input such as anhydrous or other fertilizer, nutrients, etc.) into the trench T. The frame **810** may comprise an injection assembly (e.g., sidedress liquid fertilizer injection assembly or anhydrous injection assembly) such as those illustrated in FIG. 7 of U.S. Pat. No. 5,890,445, incorporated herein by reference or in U.S. Pat. No. 8,910,581, incorporated by reference; the fluid outlets **830***a*, **830***b*, and feelers **820***a*, **820***b*, as well as related linkage structure are preferably fixed to the sides of such an injection assembly for spraying a fluid on nearby plants P-**6**.

(104) The fluid outlets **830***a*, **830***b* preferably pivot about an axis which is preferably parallel to the frame **810**. The pivot axis of the fluid outlets **830***a*, **830***b* is preferably parallel to and preferably substantially aligned with the pivot axis of the feelers **820***a*, **820***b*. As a result, a spray S (e.g., Sa, Sb) emitted from the fluid outlets **830***a*, **830***b* (e.g., via orifices **832***a*, **832***b*) preferably disposed at distal ends of the outlets) is preferably oriented toward a plant P-**7**, P-**8** contacted by the feelers **820***a*, **820***b*. A lower end of the frame **810** may also contain a fluid outlet **830***c* for emitted a spray Sc into the trench T. It should be appreciated that each fluid outlet **830***a*, **830***b* in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(105) The optional feelers **820** described herein may contact the adjacent plants at any location. In a preferred embodiment, each feeler **820** is preferably disposed to contact an adjacent plant on a stem or stalk thereof; for example, the feeler may be disposed adjacent the ground in order to contact the stalk at a location immediately above the soil (e.g., above the crown and below the lowest node of the plant). In some such embodiments, the fluid outlet **830** may be disposed above the feeler **820** instead of below the feeler **830** as illustrated in FIG. **3** in accordance with one embodiment.

(106) In another example, the application unit **800** does not include the optional feelers **820***a*, **820***b*. At least one fluid outlet (e.g., **820***a*, **820***b*) sprays or dribbles fluid towards a base region of the plants P-**7**, P-**8** while the fluid outlet **830***a* sprays or dribbles the fluid into the trench T. A distal end of at least one fluid outlet (e.g., **820***a*, **820***b*) extends closer (e.g., within 0-6 inches) to a base region of the plants when the liquid is dribbled towards the base region of the plants in comparison to when the fluid is sprayed.

(107) Referring to FIG. **8**B (rear view **852**), an embodiment of a liquid application unit **850** is illustrated which is substantially similar to the application unit **300** described herein, except that the frame **810** is coupled to or includes one or more opening discs **818** (e.g., vertical coulter) for opening a trench Tc in the soil, optional trench forming members **860** and **862** (e.g., scrapers,

knives) for opening shallow trenches Td and Te, respectively, in the soil, and no feelers. One or more feelers and related linkage mechanisms for reorienting the fluid outlet (as described herein according to various embodiments) may additionally be incorporated in the unit **850**.

(108) The frame **810** preferably includes an internal or externally mounted conduit (not shown) for applying a crop input (e.g., liquid crop input such as anhydrous or other fertilizer, nutrients, etc.) into the trenches. The frame **810** may comprise an injection assembly (e.g., sidedress liquid fertilizer injection assembly or anhydrous injection assembly) such as those illustrated in FIG. 7 of U.S. Pat. No. 5,890,445, incorporated herein by reference or in U.S. Pat. No. 8,910,581, incorporated by reference; the fluid outlets **830***a*, **830***b*, as well as related linkage structure are preferably fixed to the sides of such an injection assembly for spraying or dribbling a liquid on nearby plants.

(109) The fluid outlets **830***a*, **830***b* preferably pivot about an axis which is preferably parallel to the frame **810**. The fluid outlet **830***c* is formed near a disc **818** and the fluid outlets **830***d*, **830***e* are formed near a corresponding trench forming member **860**, **862**. As a result, a spray S (e.g., Sa, Sb, Sd, Se) or dribble emitted from the fluid outlets preferably disposed at distal ends of the outlets) is preferably oriented toward plants P-**7**, P-**8**. A lower end of the frame **810** may also contain a fluid outlet **830***c* for emitted a spray Sc into the trench T. It should be appreciated that each fluid outlet in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(110) In one example, a tractor or other implement pulls multiple side dressing fertilizer coulter units (e.g., application unit **850**) for forming a trench Tc having a depth (e.g., 4-8 inches, approximately 5-7 inches, etc.). The crop may be at a seedling stage when fertilizer is typically applied as a side dressing slightly offset laterally from each row of seedlings. Each application unit includes a frame (not shown), a coulter disc or wheel **818** for forming a deeper trench having a depth (e.g., 4-8 inches, approximately 5-7 inches, etc.) with a lateral position approximately equidistant between the plants P-**7**, P-**8**, a trench forming member **860** (e.g., scratching knife **860**) for opening a shallow trench Td having a shallow depth (e.g., 0-4 inches, 0-2 inches, approximately 1 inch) in proximity to a row of plants P-**8** (e.g., a lateral position within 5-10 inches of the plants P-**8**), and a trench forming member **862** (e.g., scratching knife **862**) for opening a shallow trench having a shallow depth (e.g., 0-4 inches, 0-2 inches, approximately 1 inch) in proximity to a row of plants P-**7** (e.g., a lateral position within 5-10 inches of the plants P-**7**). The frame **810** preferably includes an internal or externally mounted conduit (not shown) for applying a crop input (e.g., fluid crop input such as anhydrous or other fertilizer, nutrients, etc.) with fluid outlets into a respective trench. Each knife may be associated with a respective covering tine (e.g., rake, closing wheel) for closing the shallow trench to retain the crop input in the soil (or ground) and prevent the crop input from being volatilized.

(111) In another example, the disc **818** and fluid outlet **830***c* are not included in the application unit **850** and at least one of the members **860** and **862** is included in the application unit **850**. In another example, only one of the trench forming members **860** and **862** is included in the application unit **850**.

(112) FIG. **9**A illustrates a top view **902** of an application unit **900** (e.g., a fluid application unit) **900** for applying an application to plants P-**9**, P-**10** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment. It should be appreciated that the unit **900** is illustrated traveling in a direction D upwards in FIGS. **9**A and **9**B. The application unit **900** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. The application unit **900** preferably extends laterally between existing corn plants as the bar **10** illustrated in FIG. **9**C traverses the field having a ground surface **990**.

(113) In FIG. **9**A (top view), the fluid application unit **900** preferably comprises a base **912** to which linkage members **920***a*, **920***b* are preferably pivotally connected. The linkage members **920***a*,

920*b* are coupled to flexible members **922***a*, **922***b* that may contact the rows of plants in operation. In operation, when the flexible members **922***a*, **922***b* contact passing plants (e.g., P-**9**, P-**10**), the flexible members **922***a*, **922***b* preferably cause rearwardly deflection of the linkage members **920***a*, **920***b* from a neutral position **960** to a rearward deflection position as illustrated in FIGS. **9**A and **9**B. A spring element **914**, **915** or other biasing element (e.g., spring and hinge) preferably biases the linkage members **920***a*, **920***b* into a neutral position **960** to which the linkage members **920***a*, **920***b* preferably return when not deflected by a plant or other obstacle. A length of the linkage members **920***a*, **920***b* and flexible members **922***a*, **922***b* may be designed based on a row spacing (e.g., **20**″, **30**″, etc.) with each linkage member **920***a*, **920***b* having a length of approximately one half of the row spacing between rows of plants. In one example, the linkage members **920***a*, **920***b* may have adjustable lengths depending on the row spacing for a field.

(114) FIG. **9**A illustrates a top view **902** in which the linkage members **920***a*, **920***b* are biased in a centered position between rows of plants such that the base **912** is approximately equidistant from the plants P-**9** and P-**10**. FIG. **9**B illustrates a top view **904** in which the linkage members **920***a*, **920***b* are biased in a non-centered position between rows of plants such that the base **912** is laterally positioned closer to the plants P-**10** than the plants P-**9**.

(115) FIG. **9**C illustrates a side view **940** of the application unit **900** in accordance with one embodiment. The application unit **900** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. A frame **910** (e.g., rigid frame) is coupled to the bar **10** and the base **912**. In one example, the base **912** is positioned a certain distance above the ground **990**, the linkage members **920***a*, **920***b* slope downwards towards the ground, and the flexible members **922***a*, **922***b* are positioned in a horizontal plane slightly above the ground (e.g., 1-12 inches above the ground).

(116) A fluid outlet **930** can be positioned with respect to the linkage member **920***a*, **920***b* or flexible members **922***a*, **922***b* for spraying a fluid in close proximity to the plants. In one example, the fluid outlet **930** is positioned at a distal end of the linkage member **920***a*, **920***b* and generates a spray Sa that sprays in a downward directions towards a base region of plants P-**9**. It should be appreciated that each fluid outlet **930** in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(117) FIG. **9**D illustrates a top view **952** of application units **950**, **980** (e.g., a fluid application unit) for applying an application to plants P-**9**, P-**10** (e.g., corn plants, soy bean plants, etc.) in accordance with one embodiment. The application units **950**, **980** are preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. The application units **950**, **980** preferably extend laterally between existing corn plants as the bar **10** illustrated in FIG. **9**C traverses the field having a ground surface **990**.

(118) In FIG. **9**D (top view **952**), the fluid application units **950** and **980** preferably each comprise a base **912**, **972** to which linkage members **920**, **984** are preferably pivotally connected. The base **912** and **972** are each coupled with a frame to a bar **10**. The linkage members **920**, **984** are coupled to flexible members **922***a*, **982***a* that may contact the rows of plants in operation. In operation, when the flexible members **922***a*, **982***a* contact passing plants (e.g., P-**9**, P-**10**), the flexible members **922***a*, **982***a* preferably cause rearwardly deflection of the linkage members **920**, **984** from a neutral position **960** to a rearward deflection position as illustrated in FIG. **9**D. A spring element **914**, **974** or other biasing element (e.g., spring and hinge) preferably biases the linkage members **920**, **984** into a neutral position **960** to which the linkage members preferably return when not deflected by a plant or other obstacle. A length of the linkage members **920**, **984** and flexible members **922***a*, **982***a* may be designed based on a row spacing (e.g., **20**″, **30**″, etc.) with each linkage member **920**, **984** having a length of approximately one half of the row spacing between rows of plants. In one example, the linkage members **920**, **984** may have adjustable lengths depending on the row spacing for a field. Fluid outlets **930**, **981** can be positioned with respect to the linkage members **920**, **984**

or flexible members **922***a*, **982***a* for spraying a fluid in close proximity to the plants. In one example, the fluid outlet is positioned at a distal end of the linkage members **920**, **984** and generates a spray or dribble that applies in a downward direction towards a base region of plants P-**9**, P-**10**.

(119) At least one of the frame **910** and base (e.g., **912**, **972**) illustrated in FIGS. **9**A-**9**D may be coupled to or include one or more opening discs/coulter (e.g., **811***a*, **811***b*, **818**, **1318**, etc.) for opening a trench in the soil and also optional trench forming members (e.g., trench forming members **860**, **862**, **1360**, **1362**, scrapers, knives) for opening shallow trenches in the soil.

(120) FIG. **10** illustrates a side view of an application unit **1000** in accordance with one embodiment. The application unit **1000** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. A frame **1010** (e.g., rigid frame **1010**) is coupled to the bar **10**, a flexible frame **1011**, and a base **1012**. The base **1012** can be coupled to a sloped member **1014** (e.g., ski, ground contacting member) and a linkage member **1020***a* which is coupled to a flexible member **1022***a*. In one example, these components of the application unit **1000** function in a similar manner in comparison to the frame, base, linkage members, and flexible members of the application unit **900** except that the base **1012** and flexible member **1022***a* (or any other flexible member) at least partially contact the ground **1090** while in operation with the application unit **1000** moving in a direction D that is substantially parallel with respect to a row of plants P-**11**. The sloped member **1014** can partially contact the ground or be in close proximity to the ground to provide a more uniform ground surface for the base **1012** which partially contacts the ground.

(121) A fluid outlet **1030** can be positioned with respect to the linkage member or flexible members for spraying a fluid in close proximity to the plants. In one example, the fluid outlet is positioned at a distal end of the linkage member **1020***a* and generates a spray Sa that sprays in a downward direction towards a base region of plants P-**11**. It should be appreciated that each fluid outlet **1030** in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(122) In another embodiment, the application unit **1000** does not include flexible member **1022***a* and the frame **1011** or the frame **1010** may also be optional. At least one fluid outlet (e.g., **1030**) sprays the fluid towards a base region of the plants P-**11**.

(123) FIG. **11** illustrates a rear view **1102** of an application unit **1100** in accordance with one embodiment. The application unit **1100** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. A frame **1110** (e.g., rigid frame **1110**) is coupled to the bar **10**, a frame **1112** which is coupled to an optional base member **1140** having an angle **1104** with respect to the frame **1112**. The base member **1140** is positioned in a plane (e.g., a substantially horizontal plane) above the ground **1190**. The frame **1112** provides support for flexible members **1113**-**1118** and the base member **1140** may also provide support for additional flexible members (e.g., **1141**-**1142**). The flexible members have a neutral position that is parallel to a longitudinal axis of the bar **10** if the flexible members are not in contact with plants or other objects. In operation in which the application unit **1100** moves in a direction D, the flexible members contact rows of plants and bend to provide a lateral position of the frame **1110**, **1112**, and base member **1140** that is approximately equidistant with respect to rows of plants. The flexible members are arranged on the frame **1112** and optional base member **1140** in a leaf like shape and pattern of flexible members. A distal region of at least a plurality of the flexible members contains fluid outlets **1171** and **1174** for spraying fluid in close proximity to the plants.

(124) In one example, the fluid outlets are positioned approximately 0-10 inches from a distal end of a distal region of the flexible members and generate sprays Sa and Se that spray in a downward direction towards a base region of plants P-**12**, P-**13**. It should be appreciated that each fluid outlet in the various embodiments described herein is preferably in fluid communication with a source

(e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide). Each fluid outlet described herein provides a pressurized spray (e.g., 1-200 psi, 5-100 psi, etc.) in a substantially downward direction towards a base region of a plant. Alternatively, a fluid outlet may dribble liquid (non-pressurized).

(125) FIG. **12** shows an example of a system **1200** that includes a machine **1202** (e.g., tractor, combine harvester, etc.) and an implement **1240** (e.g., planter, sidedress bar, cultivator, plough, sprayer, spreader, irrigation implement, etc.) in accordance with one embodiment. The machine **1202** includes a processing system **1220**, memory **1205**, machine network **1210** (e.g., a controller area network (CAN) serial bus protocol network, an ISOBUS network, etc.), and a network interface **1215** for communicating with other systems or devices including the implement **1240**. The machine network **1210** includes sensors **1212** (e.g., speed sensors), controllers **1211** (e.g., GPS receiver, radar unit) for controlling and monitoring operations of the machine or implement. The network interface **1215** can include at least one of a GPS transceiver, a WLAN transceiver (e.g., WiFi), an infrared transceiver, a Bluetooth transceiver, Ethernet, or other interfaces from communications with other devices and systems including the implement **1240**. The network interface **1215** may be integrated with the machine network **1210** or separate from the machine network **1210** as illustrated in FIG. **12**. The I/O ports **1229** (e.g., diagnostic/on board diagnostic (OBD) port) enable communication with another data processing system or device (e.g., display devices, sensors, etc.).

(126) In one example, the machine performs operations of a tractor that is coupled to an implement for fluid applications of a field. The flow rate of a fluid application for each row unit of the implement can be associated with locational data at time of application to have a better understanding of the applied fluid for each row and region of a field. Data associated with the fluid applications can be displayed on at least one of the display devices **1225** and **1230**.

(127) The processing system **1220** may include one or more microprocessors, processors, a system on a chip (integrated circuit), or one or more microcontrollers. The processing system includes processing logic **1226** for executing software instructions of one or more programs and a communication unit **1228** (e.g., transmitter, transceiver) for transmitting and receiving communications from the machine via machine network **1210** or network interface **1215** or implement via implement network **1250** or network interface **1260**. The communication unit **1228** may be integrated with the processing system or separate from the processing system. In one embodiment, the communication unit **1228** is in data communication with the machine network **1210** and implement network **1250** via a diagnostic/OBD port of the I/O ports **1229**.

(128) Processing logic **1226** including one or more processors may process the communications received from the communication unit **1228** including agricultural data (e.g., GPS data, fluid application data, flow rates, etc.). The system **1200** includes memory **1205** for storing data and programs for execution (software **1206**) by the processing system. The memory **1205** can store, for example, software components such as fluid application software for analysis of fluid applications for performing operations of the present disclosure, or any other software application or module, images **1208** (e.g., captured images of crops), alerts, maps, etc. The memory **1205** can be any known form of a machine readable non-transitory storage medium, such as semiconductor memory (e.g., flash; SRAM; DRAM; etc.) or non-volatile memory, such as hard disks or solid-state drive. The system can also include an audio input/output subsystem (not shown) which may include a microphone and a speaker for, for example, receiving and sending voice commands or for user authentication or authorization (e.g., biometrics).

(129) The processing system **1220** communicates bi-directionally with memory **1205**, machine network **1210**, network interface **1215**, display device **1230**, display device **1225**, and I/O ports **1229** via communication links **1231**-**1236**, respectively.

(130) Display devices **1225** and **1230** can provide visual user interfaces for a user or operator. The display devices may include display controllers. In one embodiment, the display device **1225** is a

portable tablet device or computing device with a touchscreen that displays data (e.g., fluid application data, captured images, localized view map layer, high definition field maps of as-applied fluid application data, as-planted or as-harvested data or other agricultural variables or parameters, yield maps, alerts, etc.) and data generated by an agricultural data analysis software application and receives input from the user or operator for an exploded view of a region of a field, monitoring and controlling field operations. The operations may include configuration of the machine or implement, reporting of data, control of the machine or implement including sensors and controllers, and storage of the data generated. The display device **1230** may be a display (e.g., display provided by an original equipment manufacturer (OEM)) that displays images and data for a localized view map layer, as-applied fluid application data, as-planted or as-harvested data, yield data, controlling a machine (e.g., planter, tractor, combine, sprayer, etc.), steering the machine, and monitoring the machine or an implement (e.g., planter, combine, sprayer, etc.) that is connected to the machine with sensors and controllers located on the machine or implement.

(131) A cab control module **1270** may include an additional control module for enabling or disabling certain components or devices of the machine or implement. For example, if the user or operator is not able to control the machine or implement using one or more of the display devices, then the cab control module may include switches to shut down or turn off components or devices of the machine or implement.

(132) The implement **1240** (e.g., planter, cultivator, plough, sprayer, spreader, irrigation implement, etc.) includes an implement network **1250**, a processing system **1262**, a network interface **1260**, and optional input/output ports **1266** for communicating with other systems or devices including the machine **1202**. The implement network **1250** (e.g, a controller area network (CAN) serial bus protocol network, an ISOBUS network, etc.) includes a pump **1256** for pumping fluid from a storage tank(s) **1290** to application units **1280**, **1281**, . . . N of the implement, sensors **1252** (e.g., speed sensors, seed sensors for detecting passage of seed, downforce sensors, actuator valves, moisture sensors or flow sensors for a combine, speed sensors for the machine, seed force sensors for a planter, fluid application sensors for a sprayer, or vacuum, lift, lower sensors for an implement, flow sensors, etc.), controllers **1254** (e.g., GPS receiver), and the processing system **1262** for controlling and monitoring operations of the implement. The pump controls and monitors the application of the fluid to crops or soil as applied by the implement. The fluid application can be applied at any stage of crop development including within a planting trench upon planting of seeds, adjacent to a planting trench in a separate trench, or in a region that is nearby to the planting region (e.g., between rows of corn or soybeans) having seeds or crop growth.

(133) For example, the controllers may include processors in communication with a plurality of seed sensors. The processors are configured to process data (e.g., fluid application data, seed sensor data) and transmit processed data to the processing system **1262** or **1220**. The controllers and sensors may be used for monitoring motors and drives on a planter including a variable rate drive system for changing plant populations. The controllers and sensors may also provide swath control to shut off individual rows or sections of the planter. The sensors and controllers may sense changes in an electric motor that controls each row of a planter individually. These sensors and controllers may sense seed delivery speeds in a seed tube for each row of a planter.

(134) The network interface **1260** can be a GPS transceiver, a WLAN transceiver (e.g., WiFi), an infrared transceiver, a Bluetooth transceiver, Ethernet, or other interfaces from communications with other devices and systems including the machine **1202**. The network interface **1260** may be integrated with the implement network **1250** or separate from the implement network **1250** as illustrated in FIG. **12**.

(135) The processing system **1262** communicates bi-directionally with the implement network **1250**, network interface **1260**, and I/O ports **1266** via communication links **1241**-**1243**, respectively.

(136) The implement communicates with the machine via wired and possibly also wireless bi-

directional communications **1204**. The implement network **1250** may communicate directly with the machine network **1210** or via the networks interfaces **1215** and **1260**. The implement may also by physically coupled to the machine for agricultural operations (e.g., planting, harvesting, spraying, etc.).

(137) The memory **1205** may be a machine-accessible non-transitory medium on which is stored one or more sets of instructions (e.g., software **1206**) embodying any one or more of the methodologies or functions described herein. The software **1206** may also reside, completely or at least partially, within the memory **1205** and/or within the processing system **1220** during execution thereof by the system **1200**, the memory and the processing system also constituting machine-accessible storage media. The software **1206** may further be transmitted or received over a network via the network interface **1215**.

(138) In one embodiment, a machine-accessible non-transitory medium (e.g., memory **1205**) contains executable computer program instructions which when executed by a data processing system cause the system to performs operations or methods of the present disclosure. While the machine-accessible non-transitory medium (e.g., memory **1205**) is shown in an exemplary embodiment to be a single medium, the term "machine-accessible non-transitory medium" should be taken to include a single medium or multiple media (e.g., a centralized or distributed database, and/or associated caches and servers) that store the one or more sets of instructions. The term "machine-accessible non-transitory medium" shall also be taken to include any medium that is capable of storing, encoding or carrying a set of instructions for execution by the machine and that cause the machine to perform any one or more of the methodologies of the present disclosure. The term "machine-accessible non-transitory medium" shall accordingly be taken to include, but not be limited to, solid-state memories, optical and magnetic media, and carrier wave signals.

(139) Referring to FIG. **13**A (side view), an embodiment of a fluid application unit **1300** is illustrated in accordance with one embodiment. A tractor or other implement pulls multiple side dressing fertilizer coulter units (e.g., application unit **1300**). The crop may be at a seedling stage when fertilizer is typically applied as a side dressing slightly offset laterally from each row of seedlings. Each application unit includes a frame **1310**, a member **1316** for supporting a coulter wheel **1318** (e.g., single disc, double disc), a member **1314** for supporting a shallow trench forming member **1342** (e.g., scratching knife **1342**) for opening a shallow trench in the soil having a shallow depth (e.g., 0-4 inches, 0-2 inches, approximately 1 inch). The frame **1310** preferably includes an internal or externally mounted conduit (not shown) for applying a crop input (e.g., fluid crop input such as anhydrous or other fertilizer, nutrients, etc.) with a fluid outlet **1340** into the shallow trench. A covering tine **1330** (e.g., rake, closing wheel) closes the shallow trench to retain the crop input in the soil (or ground **1390**). A spring pivot **1312** allows the member **1314** and fluid outlet **1340** to pivot with a range of motion **1315** with respect to the member **1316**.

(140) The frame **1310** may comprise an injection assembly (e.g., sidedress liquid fertilizer injection assembly or anhydrous injection assembly) such as those illustrated in FIG. 7 of U.S. Pat. No. 5,890,445, incorporated herein by reference or in U.S. Pat. No. 8,910,581, incorporated by reference. The frame **1310** and application unit **1300** can be used in combination with any other embodiments of the present disclosure. In one example, the feelers **820***a*, **820***b* and fluid outlets **830***a*, **830***b* of FIG. **8** are used in combination with the frame **1310** and application unit **1300**.

(141) FIG. **13**B (top view) illustrates an embodiment of a liquid application unit **1350** having multiple trench forming members (e.g., knives) and fluid outlets in accordance with one embodiment. A tractor or other implement pulls multiple side dressing fertilizer coulter units (e.g., application unit **1350**) for forming a trench having a depth (e.g., 4-8 inches, approximately 5-7 inches, etc.). The crop may be at a seedling stage when fertilizer is typically applied as a side dressing slightly offset laterally from each row of seedlings. Each application unit includes a frame (not shown), a coulter wheel **1318** for forming a deeper trench having a depth (e.g., 4-8 inches, approximately 5-7 inches, etc.), a trench forming member **1360** (e.g., scratching knife **1360**) for

opening a shallow trench having a shallow depth (e.g., 0-4 inches, 0-2 inches, approximately 1 inch) in proximity to a row of plants P-**14**, and a trench forming member **1362** (e.g., scratching knife **1362**) for opening a shallow trench having a shallow depth (e.g., 0-4 inches, 0-2 inches, approximately 1 inch) in proximity to a row of plants P-**15**. The frame preferably includes an internal or externally mounted conduit (not shown) for applying a crop input (e.g., fluid crop input such as anhydrous or other fertilizer, nutrients, etc.) with fluid outlets **1371**-**1372** into a respective trench. Each knife may be associated with a respective covering tine **1331**-**1332** (e.g., rake, closing wheel) for closing the shallow trench to retain the crop input in the soil (or ground) and prevent the crop input from being volatilized.

(142) In another example, the knife **1342**, fluid outlet **1340**, and member **1314** may optionally be included with the application unit **1350**, coupled to the member **1316**, and have a lateral position that is approximately equidistant with respect to the rows of plants P-**14**, P-**15**. The knife **1360** has a lateral position that is approximately within 5-10 inches of the plants P-**14** while the knife **1362** has a lateral position that is approximately within 5-10 inches of the plants P-**15**. In this manner, crop input can be supplied at any desired location at any desired depth within approximately 5 inches of a row of plants. Any desired percentage of crop input can be applied to each fluid outlet **1340**, **1371**-**1372** for optimal plant growth. In one example, a first percentage of a crop input is applied to the fluid outlet **1340** and a second percentage of a crop input is applied to the fluid outlets **1371** and **1372**.

(143) Where reference is made to a fluid/liquid as to any of the various embodiments disclosed herein, it should be appreciated that any fluid may be similarly transferred and applied by such embodiments; e.g., in a liquid, gaseous, dense phase or transitional phase.

(144) For each of the fluid application unit embodiments described herein, multiple units are preferably disposed along the length of the bar, e.g., such that one, two or more rows of plants are disposed between each unit.

(145) FIG. **14** illustrates an adjustable bracket **1400** for coupling any of the frames described herein to a bar **10** in accordance with one embodiment. The bracket **1400** is preferably adjustable such that the frame (e.g., frames **310**, **410**, **510**, **610**, **710**, **810**, **910**) of any of the embodiments disclosed herein may be mounted to any bar (e.g., bar **10**) having variable size and cross-sectional shape. In the illustrated embodiment, a rotating member **1432** (e.g., dial **1432**) may be manipulated or rotated by the installer to adjust a position of a retaining member **1434** in order to retain the bracket **1400** on bars **10** having various widths. In the illustrated embodiment the bracket **900** includes two separable portions **1440**, **1450** which may be separated for installation and then secured to one another such as by bolts (not shown). The frame **1410** may be fixed to the bracket **1400** by U-bolts **1412***a*, **1412***b* and/or by any quick coupling structure known in the art.

(146) FIG. **15**A illustrates an isometric view of an application unit **1500** in accordance with one embodiment. The application unit **1500** is preferably mounted to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. A frame **1510** (e.g., rigid frame **1510**) is coupled to the bar **10**, a frame **1511** (flexible frame, rigid frame), and a base **1512**. It should be appreciated that frame **1510** and **1511** could be a unitary part. The base **1512** includes a biasing element **1513** (e.g., spring) to bias or position linkage members **1520***a*, **1520***b* outwards towards rows of plants P-**16**, P-**17**. The base **1512** also includes pins **1514***a*, **1514***b* positioned in holes to set a width for biasing of the linkage members for different crop row spacing. The base **1512** includes additional holes **1515***a*, **1515***b* and **1516***a*, **1516***b* to reduce a width of the linkage members **1520***a*, **1520***b* to adjust for different crop row spacing or for different types of crops. For a turn of a tractor and an implement having a plurality of application units **1500**, the biasing element and pins cause the flexible members to flex inwards. Optionally, a rotating swivel **1570** or **1571** can be disposed between bar **10** and frame **1510** and/or between frame **1511** and base **1512**. The degree of rotation can be any desired degree, but actual rotation will be limited by the movement in the rows. Having a rotating swivel **1570** or **1571** provides more flexibility during use to keep

application unit **1500** in the row without providing too much force on the plants.
(147) The biasing element **1513** biases angular positions of the first and second linkage members **1520***a* and **1520***b* such that distal ends **1521***a*, **1521***b* of the linkage members have a spacing **1525** that is similar to a row spacing of the rows of plants P-**16**, P-**17**.
(148) In another embodiment, biasing element **1513** can be replaced with a pressure actuated biased return pistons **1540***a* and **1540***b* shown in an isometric view of an application unit **1532** in FIG. **15**B. Pressure actuated biased return pistons **1540***a* and **1540***b* are oppositely disposed and coupled with a coupler **1541**, which has a fluid inlet **1542** for supplying pressure to pressure actuated biased return pistons **1540***a* and **1540***b* through the coupler **1541**. The pistons in the pressure actuated biased return pistons **1540***a* and **1540***b* are in communication with pivots **1543***a* and **1543***b*, respectively, disposed on base **1512** at the edges of base **1512**. Pivots **1543***a* and **1543***b* are disposed on base **1512** via pins **1544***a* and **1544***b*, respectively. Linkage members **1520***a* and **1520***b* are disposed on pivots **1543***a* and **1543***b*, respectively. Linkages **1520***a* and **1520***b* have fluid inlets **1520**-*la* and **1520**-**1***b*, respectively, and are in fluid communication with the fluid system. Pressure actuated biased return pistons **1540***a* and **1540***b* connect to pivots **1543***a* and **1543***b* between pins **1544***a* and **1544***b* and base edge **1512***a*. As shown in FIG. **15**B, pressure actuated biased return pistons **1540***a* and **1540***b* are directly connected to pivots **1543***a* and **1543***b*, respectively, but they could also be connected through optional pivot connections **1545***a* and **1545***b*, respectively, similar to connectors **1705***a* and **1705***b* in FIG. **17**A.
(149) Similar to as shown in FIG. **15**B for the pressure actuated biased return pistons that are similar to the pressure actuated biased return pistons in FIG. **17**A, any of the embodiments in FIGS. **17**D to **19**C can also be disposed on base **1512**.
(150) The fluid to drive the pistons can be from the fluid, or it can be from a pneumatic or hydraulic system on the toolbar (not shown). With the fluid system, when fluid is applied, the pressure in the fluid system will cause the pressure actuated biased return pistons **1540***a* and **1540***b* to bias outwards to the edge of base **1512**. When the fluid application is turned off, the biased return in the pressure actuated biased return pistons **1540***a* and **1540***b* will bias the piston toward the middle of base **1512**. For the pneumatic or hydraulic system, these can be activated manually or automatically when the fluid system is turned on.
(151) The benefit of having the dual direction biasing is that the linkage members **1520***a* and **1520***b* will bias outwards towards the plants during fluid application, and will bias toward the middle of the row when the fluid system is not on. By having the linkage members **1520***a* and **1520***b* bias toward the middle of the row, application unit (e.g., **1500**, **1532**, etc.) can be reversed down the row. This can be helpful when steering causes misalignment in a row, and the application unit (e.g., **1500**, **1532**) needs to back up to correct the steering. If linkage members **1520***a* and **1520***b* are always biased towards the plants, they would catch and fold over the plants if run in a reversed direction.
(152) The linkage members **1520***a*, **1520***b* are coupled to flexible members **1522***a*, **1522***b* respectively. In one example, the linkage members position the flexible members **1522***a*, **1522***b* in close proximity to a target region of the plants. The flexible members **1522***a*, **1522***b* can be any type of flexible material (e.g., hoses) or can be replaced with pipes. It should be appreciated that linkage members **1520***a*, **1520***b* and flexible members **1522***a*, **1522***b*, respectively, can be made as unitary parts. In one example, these components of the application unit **1500** function in a similar manner in comparison to the frame, base, linkage members, and flexible members of the application unit **1000** with the ground contacting members **1524***a*, **1524***b* (e.g., ski, skid, wear element, etc.) at least partially contacting the ground while in operation with the application unit **1500** moving in a direction D that is substantially parallel with respect to rows of plants P-**16** and P-**17**. The ground contacting members **1524***a*, **1524***b* substantially prevent the flexible members **1522***a*, **1522***b* from contacting the ground and thus reduce wear on the flexible members **1522***a*, **1522***b*. The ground contacting members **1524***a*, **1524***b* also position the flexible members **1522***a*,

1522*b* to be slightly elevated (e.g., 0 to 3 inches) above the ground.
(153) Fluid outlets **1530***a*, **1530***b* (e.g., spray nozzle, drip mechanism) are positioned with respect to a distal portion **1528***a*, **1528***b* of flexible members **1522***a*, **1522***b* for spraying a fluid in close proximity to the plants. In one example, the fluid outlets are positioned at a distal end of the distal portions of the flexible members and generate a spray Sa, Sb that sprays in a downward direction towards a base region of plants P-**16**, P-**17**, respectively. It should be appreciated that each fluid outlet in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).
(154) In another embodiment, the application unit **1500** optionally includes a housing member **1580** for positioning a plurality of fluid outlets (e.g., **1581**-**1585**) at a plurality of different angles (e.g., angled down towards ground, angle outwards from the housing member **1580**) having a maximum range of approximately 180 degrees. Additional or fewer fluid outlets can be positioned with the housing member **1580**. Each fluid outlet can have a fixed position or an adjustable angular position for spraying a fluid towards a base region of the plants or towards a certain target region between the rows of plants P-**16**, P-**17**. The fluid sprayed by the fluid outlets **1581**-**1585** can be the same fluid that is spraying by the fluid outlets **1530***a*, **1530***b* or this fluid can be different. In one example, the fluid outlets **1581**-**1585** spray a fungicide.
(155) The frame (e.g., **1510**, **1511**), base, linkage members, and flexible members preferably include an internal or externally mounted conduit (not shown) for applying a crop input (e.g., fluid crop input such as anhydrous or other fertilizer, nutrients, etc.) towards a target region of the plants or into trenches. The frame may comprise an injection assembly (e.g., sidedress liquid fertilizer injection assembly or anhydrous injection assembly) such as those illustrated in FIG. 7 of U.S. Pat. No. 5,890,445, incorporated herein by reference or in U.S. Pat. No. 8,910,581, incorporated by reference; the fluid outlets, as well as related linkage structure are preferably fixed to the sides of such an injection assembly for spraying or dribbling a liquid on nearby plants or towards a target region of the plants.
(156) FIG. **16** illustrates an isometric view of an application unit **1600** positioned in proximity to rows of plants in accordance with one embodiment. The application unit **1600** includes similar components and functionality in comparison to the application unit **1500** of FIG. **15**. The application unit **1600** is preferably mounted to a transversely extending bar **10** (not shown in FIG. **16**) drawn by a tractor or other implement. A frame **1610** (e.g., **1510**, **1511**) is coupled to the bar **10**, and a base **1612**. The base **1612** includes a biasing element **1613** (e.g., spring) to bias or position linkage members **1620***a*, **1620***b* outwards towards rows of plants P-**18**, P-**19**. The linkage members **1620***a*, **1620***b* are coupled to flexible members **1622***a*, **1622***b* respectively. The flexible members can be any type of flexible material (e.g., hoses) or can be replaced with pipes. In one example, the ground contacting members **1624***a*, **1624***b* (e.g., ski, skid, wear element, etc.) at least partially contact the ground **1690** while in operation with the application unit **1600** moving in a direction D that is substantially parallel with respect to rows of plants P-**18** and P-**19**. The ground contacting members **1624***a*, **1624***b* substantially prevent the flexible members **1622***a*, **1622***b* from contacting the ground and thus reduce wear on the flexible members **1622***a*, **1622***b*. The ground contacting members **1624***a*, **1624***b* also position the flexible members **1622***a*, **1622***b* to be slightly elevated (e.g., 0 to 3 inches) above the ground.
(157) Fluid outlets **1630***a*, **1630***b* (e.g., spray nozzle, drip mechanism) are positioned with respect to a distal end of flexible members for spraying a fluid in close proximity to the plants. In one example, the fluid outlets generate spray Sa, Sb that sprays in a downward direction towards a base region of plants P-**18**, P-**19**, respectively. It should be appreciated that each fluid outlet in the various embodiments described herein is preferably in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(158) FIG. **17**A illustrates an isometric view of an application unit **1700** for mounting to a coulter fertilizer disc **1790**. Coulter fertilizer disc **1790** has a toolbar arm **1799** for connection to bar **10**. Attached to toolbar arm **1799** is a bracket **1793** for connecting coulter mounting arm **1792**. At the opposing end, disc **1791** is mounted to coulter mounting arm **1792** along with blade mounting arm **1794** disposed rearward of the direction of travel of coulter fertilizer disc **1790**. Connected to blade mounting arm **1794** is a blade **1795** (or a sprayer not shown) with fluid line **1796**. Application unit **1700** has a bracket **1701** (generally shown with a U shape) that connects to where blade **1795** (or sprayer) connects to blade mounting arm **1794** with a closed end of the bracket **1702** forward of disc **1791**. Application unit **1700** is used in conjunction with the embodiments of FIGS. **17**B to **19**C below, which show application unit **1700** in partial.
(159) Disposed near closed end of the bracket **1702** are pivots **1703***a* and **1703***b* that are disposed on bracket **1701** through pins **1704***a* and **1704***b*, respectively as illustrated in isometric view **1750** of FIG. **17**B and side view **1752** of FIG. **17**C in accordance with one embodiment. Actuating the pivots **1703***a* and **1703***b* are pressure actuated biased return pistons **1710***a* and **1710***b*, respectively. Pressure actuated biased return pistons **1710***a* and **1710***b* can directly connect to pivots **1703***a* and **1703***b* as shown in FIG. **15**B for pressure actuated biased return pistons **1540***a* and **1540***b* to pivots **1543***a* and **1543***b*. Alternatively, pressure actuated biased return pistons **1710***a* and **1710***b* can connect through piston arms **1708***a* and **1708***b*, respectively, and connectors **1705***a* and **1705***b*, respectively, to pivots **1703***a* and **1703***b*, respectively. In either embodiment, the connection on the side of the pins **1704***a* and **1704***b* is away from closed end of the bracket **1702**. Disposed between pressure actuated biased return pistons **1710***a* and **1710***b* is a coupler **1711** having a fluid inlet **1712**. Connected to pivots **1703***a* and **1703***b* are linkages **1720***a* and **1720***b*, respectively. Linkages **1720***a* and **1720***b* (e.g., arms) have fluid inlets **1721***a* and **1721***b*, respectively, and are in fluid communication with the fluid system.
(160) The fluid to drive the pistons is described above for application unit **1500**.
(161) FIG. **17**D illustrates an isometric view of an application unit **1780** in accordance with another embodiment. This application unit **1780** includes similar components in comparison to the components of application unit **1750** of FIG. **17**B, except that linkage members **1520***a*′ and **1520***b*′ include distal portions that curve inwards towards each other. Any of the other embodiments discussed herein may also have linkage members **1520***a* and **1520***b* having a similar inwards curvature.
(162) In other alternatives shown in FIGS. **18**A and **18**B, the fluid actuation with the pressure actuated biased return pistons **1710***a* and **1710***b* are replaced by solenoids **1810***a* and **1810***b*, which are disposed on bracket **1702** via brackets **1811***a* and **1811***b*, respectively, as illustrated in application unit **1800** of FIG. **18**A. Solenoids **1810***a* and **1810***b* are activated by an electrical switch (not shown). In place of solenoids **1810***a* and **1810***b* can be electric motors **1820***a* and **1820***b*, respectively, as illustrated in application unit **1850** of FIG. **18**B.
(163) In other alternatives shown in linkage systems **1990**-**1992** of FIGS. **19**A to **19**C, respectively, the fluid actuation with the pressure actuated biased return pistons **1710***a* and **1710***b* are replaced by linkage system **1990**, which is disposed on bracket **1702** via bracket **1960**. Linkage system **1990** has an actuator **1951** in communication with gear box **1950** for acting on linkage arms **1952***a* and **1952***b*. Linkage arms **1952***a* and **1952***b* are connected to connectors **1705***a* and **1705***b*, respectively, or directly to pivots **1703***a* and **1703***b*, respectively (not shown). Actuator **1951** can be actuated by solenoid **1910** in FIG. **19**A or electrical motor **1920** of linkage system **1991** in FIG. **19**B, which are disposed on bracket **1702** via bracket **1911**. Solenoid **1910** and electrical motor are activated by an electrical switch (not shown). Alternatively, actuator **1951** can be actuated by ground contacting arm **1940** of linkage system **1992** as illustrated in FIG. **19**C. When ground contacting arm **1940** contacts the ground, ground contacting arm causes pivot **1941** to pivot and actuate actuator **1951**.
(164) The linkage members (arms) discussed herein can be actuated with solenoids, electrical motors, or via a linkage using at least one solenoid, motor, or ground contact. The electrical switch

in the above embodiments can be a separate switch activated by an operator when coulter fertilizer disc **1790** is lowered to the ground, or the electrical switch can activated when the coulter fertilizer disc **1790** is commanded to be lowered. Alternatively, the electrical switch can be activated by ground contact.

(165) The following examples pertain to further embodiments. Specifics in the examples may be used anywhere in one or more embodiments.

(166) For example, in one embodiment, an application unit includes a frame to be positioned in operation between first and second rows of plants, a first plant contacting member being pivotally coupled to the frame in operation such that the first plant contacting member to be deflected rearwardly with respect to a direction of motion of the frame upon the first plant contacting member contacting at least one of the plants of the first row of plants which causes a first change in orientation of the first plant contacting member with respect to the frame. A first outlet applies a fluid application to the first row of plants with the first outlet being mechanically linked to the first plant contacting member. The first change in orientation causes a corresponding second change in orientation of the first outlet with respect to the frame.

(167) In another example, the application unit further includes a second plant contacting member being pivotally coupled to the frame in operation such that the second plant contacting member to be deflected rearwardly with respect to the direction of motion of the frame upon the second plant contacting member contacting at least one of the plants of the second row of plants which causes a third change in orientation of the second plant contacting member with respect to the frame. A second outlet applies a fluid application to the second row of plants with the second outlet being mechanically linked to the second plant contacting member. The third change in orientation causes a corresponding fourth change in orientation of the second outlet with respect to the frame.

(168) In another embodiment, an application unit includes a frame to be positioned in operation between two rows of plants and a base member coupled to the frame. The base member to be positioned in proximity to a ground surface while in operation. First and second plant guidance members are coupled to the base member in operation such that the first and second plant guidance members guide a lateral position of the base member to be approximately equidistant from the two rows of plants based upon whether at least one of the first and second plant guidance members contacts one or more plants of the two rows of plants.

(169) In one example, the application unit further includes first and second outlets coupled to the base member in operation such that a change in lateral position of the base member causes a corresponding change in position of the first and second outlets for applying a fluid application to the plants.

(170) In another embodiment, a closer **2010** or closer **2020** can be disposed after coulter fertilizer disk **1790** in a direction of travel DT of the coulter fertilizer disk **1790**. Different embodiments of closer **2010** are illustrated in FIGS. **20**A to **20**F, and closer **2020** is illustrated in FIGS. **21**A to **21**B. FIG. **20**A is a side elevation view of a closer on a coulter wheel according to one embodiment. FIG. **20**B is a rear view of the closer of FIG. **20**A according to one embodiment in which the top and bottom of the arms are equidistant to the axis through the trench and the front and back of the arms are equidistant to the axis through the trench. FIG. **20**C is a rear view of the closer of FIG. **20**A according to one embodiment in which the bottom of the arms are closer to the axis through the trench than the top of the arms. FIG. **20**D is a rear view of the closer of FIG. **20**A according to one embodiment in which the back of the arms are closer to the axis through the trench than the front of the arms.

(171) FIG. **20**E is a rear view of the closer of FIG. **20**A according to one embodiment in which the bottom of the arms are closer to the axis through the trench than the top of the arms and the back of the arms are closer to the axis through the trench than the front of the arms. FIG. **20**F is a side view of the closer of FIG. **20**B according to one embodiment in which the bottom of the arm is at least partially disposed behind the top of the arm in a direction of travel.

(172) FIG. **21**A is a side elevation view of an alternative closer disposed on a blade according to one embodiment.
(173) FIG. **21**B is a rear elevation view of the blade and closer of FIG. **21**A.
(174) The embodiments of closer **2010** or closer **2020** can all be used with the embodiment illustrated in FIG. **17**A, which further includes blade **1795**. Closer **2010** or closer **2020** can be disposed behind blade **1795** of FIG. **17**A in a direction of travel DT of the coulter fertilizer disk **1790** by attachment to blade mounting arm **1794** or attachment to blade **1795**. Also, blade **1795** from FIG. **17**A can be disposed on mounting arm **2005** instead of blade mounting arm **1794**.
(175) Closer **2010** has a top bar **2011** and at least one arm **2012** disposed downwardly from top bar **2011**. Top bar **2011** can be disposed on mounting arm **2005** by any suitable attachment, such as welding, bolting, or riveting. Top bar **2011** can be generally horizontal, and extends transversely across a trench T created by disk **1791** and/or blade **1795**. In one embodiment, there can be two arms **2012-1** and **2012-2** disposed on top bar **2011** as illustrated in FIG. **20**B.
(176) Arm **2012** has a top edge **2012***t*, a bottom edge **2012***b*, a front edge **2012***f*, and a back edge **2012***bk*. Arm **2012** (or arms **2012-1** and **2012-2** having the same top edge **2012***t*-**1**, **2012***t*-**2**; bottom edge **2012***b*-**1**, **2012***b*-**2**; front edge **2012***f*-**1**, **2012***f*-**2**; and back edge **2012***bk*-**1**, **2012***bk*-**2**) can be disposed according to one or more of the following configurations with respect to an axis through trench T along a direction of travel DT of coulter fertilizer disk **1790**: the bottom edge **2012***b* (**2012***b*-**1**, **2012***b*-**2**) and the top edge **2012***t* (**2012***t*-**1**, **2012***t*-**2**) are equidistant to the axis (illustrated in FIG. **20**B); the bottom edge **2012***b* (**2012***b*-**1**, **2012***b*-**2**) is closer to the axis than the top edge **2012***t* (**2012***t*-**1**, **2012***t*-**2**) (illustrated in FIG. **20**C); the back edge **2012***bk* (**2012***bk*-**1**, **2012***bk*-**2**) is closer to the axis than the front edge **2012***f* (**2012***f*-**1**, **2012***f*-**2**) (illustrated in FIG. **20**D); both the bottom edge **2012***b* (**2012***b*-**1**, **2012***b*-**2**) is closer to the axis than the top edge **2012***t* (**2012***t*-**1**, **2012***t*-**2**) and the back edge **2012***bk* (**2012***bk*-**1**, **2012***bk*-**2**) is closer to the axis than the front edge **2012***f* (**2012***f*-**1**, **2012***f*-**2**) (illustrated in FIG. **20**E); or the bottom edge **2012***b* (**2012***b*-**1**, **2012***b*-**2**) is disposed at least partially behind the top edge **2012***t* (**2012***t*-**1**, **2012***t*-**2**) along a direction of travel DT (illustrated in FIG. **20**F using the embodiment from FIG. **20**B. While illustrated with the embodiment from FIG. **20**B, the embodiment from FIG. **20**F can be used with any of the embodiments illustrated in any of FIGS. **20**C, **20**D, and **20**E.
(177) As illustrated in FIGS. **21**A and **21**B, closer **2010** can be replaced with closer **2020**. In this embodiment, closer **2020** is disposed on blade **1795**. Closer **2020** has a planer shape and a width that extends over the trench T created by disk **1791**. As coulter fertilizer disk **1790** traverses a field and creates a trench T, closer **2020** levels soil displaced by disk **1791** and/or blade **1795**.
(178) As shown, closer **2010** or closer **2020** is connected to mounting arm **2005** or knife **1795**, respectively. Alternative, closer **2010**, closer **2020** can be connected to bar **10** by a mounting arm (not shown).
(179) FIGS. **22**A and **22**B illustrate a nozzle **3000** that can be disposed at the end of the fluid lines described herein (such as flexible member **922**, flexible member **982**, flexible member **1022**, flexible member **1522**, linkage member **1520**, or fluid outlets **1530**). Fluid line **3010** is connected to a nozzle housing **3021**. Nozzle housing **3021** has a nozzle **3022** disposed opposite to the fluid line **3010**. Nozzle housing **3021** and nozzle **3022** can be a unitary part or separate parts. Nozzle **3022** has an outlet **3023** disposed in nozzle **3022** for dispensing fluid. As shown, outlet **3023** is disposed downward towards the ground. Also, outlet **3023** can be disposed on the side facing towards plants (not shown). Outlet **3023** can optionally have an aerator **3025** disposed in itself to regulate the flow fluid. Nozzle housing **3021** further includes a ski **3030** (such as a spring wire) disposed through nozzle housing **3021** and extending backward away from nozzle housing **3021** for engaging the ground to keep the nozzle outlet **3023** from contacting the ground to improve fluid flow.
(180) FIG. **23** illustrates a flexible member **3050** that includes a reinforcement **3051** disposed on or in flexible member **3050**. This embodiment can be used with any flexible member described herein (such as flexible member **922**, flexible member **982**, flexible member **1022**, or flexible member

1522). An unreinforced flexible member, such as a hose, can flop around while being drawn through a field. This can cause fluid to not be dispensed in the selected area. Reinforcement **3051** can add stiffness to flexible member **3050** and to keep flexible member **3050** biased against plants. In one embodiment, reinforcement **3051** is a wire.

(181) Illustrated in FIGS. **24**A and **24**B is cradle **3100***a*, which can be used to hold member **3110***a* (such as flexible member **922**, flexible member **982**, flexible member **1022**, flexible member **1522**, linkage member **1520**, or fluid outlets **1530**) when used in conjunction with any of the application units **1700**, **1750**, **1752**, **1780**, **1800**, **1850**, or **1992** as illustrated in FIGS. **17**A to **19**C. When disk **1791** is raised for transport, member **3110***a* will tend to drag towards the ground under the pull of gravity. Cradle **3100***a* can be disposed on bracket **1701** transverse to the direction of travel. Member **3110***a* can be stored in cradle **3100***a*. Optionally, member **3110***a* is latchable in cradle **3100***a* with latch **3101***a*, which is hingably engaged with cradle **3100***a*. Side a is illustrated, but side b has the same configuration on the other side.

(182) FIG. **25** illustrates an application unit **3200** as an alternative embodiment for application unit **1500** illustrated in FIG. **15**A. Base **1512** is replaced with base **3212**, and linkage members **1520***a*, **1520***b* are replaced by linkage members **3220***a*, **3220***b*, respectively. Linkage members **3220***a*, **3220***b* are pivotally connected to base **3212** through pivots **3201***a*, **3201***b*, respectively. Linkage members **3220***a*, **3220***b* have a portion **3221***a*, **3221***b* that extend forward of base **3212** in a direction of travel. Base **3212** has walls **3202***a*, **3202***b* extending forward of base **3212** in a direction of travel. Biasing members **3203***a*, **3203***b* (such as a spring) are disposed between walls **3202***a*, **3202***b* and portions **3221***a*, **3221***b*, respectively, to bias portions **3221***a*, **3221***b* away from walls **3202***a*, **3202***b* so that flexible members **3222***a*, **3222***b* are biased towards the plants.

(183) FIG. **26** illustrates an embodiment in which a flexible member **3322** (such as flexible member **922**, flexible member **982**, flexible member **1022**, or flexible member **1522**) has a spring **3303***a*, **3303***b* disposed over flexible member **3322** (e.g., **3322***a*, **3322***b*) proximate to the end opposite of the discharge of flexible member **3322**. Spring **3303** can be the only biasing in the application unit, or spring **3303** can be used with any other biasing described herein. Components of the nozzle **3000** of FIG. **22**A are coupled to the flexible member **3322***a* and **3322***b*. The nozzle **3000** includes fluid line **3010** (e.g., **3010***a*, **3010***b*) that is connected to a nozzle housing **3021** (e.g., **3021***a*, **3021***b*). Nozzle housing **3021** has a nozzle **3022** (e.g., **3022***a*, **3022***b*) disposed opposite to the fluid line **3010**. Nozzle housing **3021** and nozzle **3022** can be a unitary part or separate parts. Nozzle **3022** has an outlet **3023** (e.g., **3023***a*, **3023***b*) disposed in nozzle **3022** for dispensing fluid. As shown, outlet **3023** is disposed downward towards the ground. Also, outlet **3023** can be disposed on the side facing towards plants. Outlet **3023** can optionally have an aerator **3025** disposed in itself to regulate the flow fluid (not shown).

(184) FIGS. **27**A to **27**G illustrate another embodiment for an application unit **2700**. Application unit **2700** is connected to a vertical support **2799**, which is connected to a transversely extending bar **10** (e.g., toolbar or boom) drawn by a tractor or other implement. Vertical support **2799** can have a length such that application unit **2700** is disposed at the bottom of vertical support **2799** proximate to the ground. An optional coulter assembly **2780** can also be connected to vertical support **2799** posterior to application unit **2700** in a direction of travel. In one embodiment that does not include coulter assembly **2780**, vertical support **2799** can have a length so that application unit **2700** is proximate to the ground. Or vertical support **2799** can have a length that extends to where coulter assembly **2780** attaches, and application unit **2700** attaches to vertical support proximate to where coulter assembly attaches. Even when coulter assembly **2780** is not included, there is an advantage to having application unit **2700** disposed above the ground and not proximate to the ground to avoid having application unit **2700** from impacting the ground as contoured terrain is encountered.

(185) Application unit **2700** includes a bracket **2701** for connecting to vertical support **2799**. Connected to bracket **2701** is a pivot **2705** having a vertical axis to permit application unit **2700** to

pivot in a horizontal plane. This allows application unit **2700** to freely pivot to provide self-alignment between adjacent rows of plants in the event that application unit **2700** is not centered between the rows during operation. Optionally, a deflector **2710** is disposed on the front of application unit **2700** in the direction of travel. Deflector **2710** is connected via a deflector bracket **2711** to bracket **2701**. In one embodiment, deflector bracket **2711** has arms **2712***a*, **2712***b*, which can be a unitary part or separate parts.

(186) The description below is for both sides of application unit **2700**. For clarity, one side of application unit is illustrated in the drawings. It is understood, that the same parts are also disposed on the other side of application unit **2700**.

(187) Disposed below pivot **2705** is bracket base **2702**. Pivotally connected to bracket base **2702** is bracket assembly **2740** (**2740***a*, **2740***b*) through pivot **2747** (**2747***a*, **2747***b*) on a horizontal axis to permit vertical rotation of bracket assembly **2740** (**2740***a*, **2740***b*). Pivotally connected to bracket assembly **2740** (**2740***a*, **2740***b*) is bracket assembly **2730** (**2730***a*, **2730***b*) through pivot **2737** (**2737***a*, **3737***b*) to permit rotation transverse to the direction of travel.

(188) Bracket assembly **2730** (**2730***a*, **2730***b*) has a bracket base **2731** (**2731***a*, **2731***b*). Connected to bracket base **2731** (**2731***a*, **2731***b*) is a fluid arm **2720** (**2720***a*, **2720***b*). Connected to fluid arm **2720** (**2720***a*, **2720***b*) is a fluid line **2722** (**2722***a*, **2722***b*), which is fluid communication with a fluid source (e.g., tank **250**). Bracket base **2731** (**2731***a*, **2731***b*) is biased outward by bias element **2735** (**2735***a*, **2735***b*). Bias element **2735** (**2735***a*, **2735***b*), such as a spring, is disposed over element **2734** (**2734***a*, **2734***b*), which is connected to a bracket **2732** (**2732***a*, **2732***b*), which is connected to bracket base **2741** (**2741***a*, **2741***b*). Element **2734** (**2734***a*, **2734***b*) is disposed through a bracket **2733** (**2733***a*, **2733***b*). Bias element **2735** (**2735***a*, **2735***b*) is disposed over element **2734** (**2734***a*, **2734***b*) between a stop **2736** (**2736***a*, **2736***b*) and a side of bracket **2733** (**2733***a*, **2733***b*) away from bracket **2732** (**2732***a*, **2732***b*).

(189) Bracket assembly **2740** (**2740***a*, **2740***b*) includes a bracket base **2741** (**2741***a*, **2741***b*). Bias element **2745** (**2745***a*, **2745***b*), such as a spring, is disposed over element **2744** (**2734***a*, **2744***b*), which is connected to a bracket **2742** (**2742***a*, **2742***b*), which is connected to bracket base **2741** (**2741***a*, **2741***b*). Element **2744** (**2744***a*, **2744***b*) is disposed through a bracket **2709**, which is connected to bracket base **2702**. Bias element **2745** (**2745***a*, **2745***b*) is disposed over element **2744** (**2744***a*, **2744***b*) between a stop **2746** (**2746***a*, **2746***b*) and a side of bracket **2709** away from bracket **2742** (**2742***a*, **2742***b*). Optionally, as illustrated in FIG. **27**G, bias element **2748** (**2748***a*, **2748***b*) is disposed over element **2744** (**2744***a*, **2744***b*) on a side of bracket **2709** opposite to biasing element **2745** (**2745***a*, **2745***b*). Balancing the amount of bias between bias element **2745** (**2745***a*, **2745***b*) and bias element **2748** (**2748***a*, **2748***b*) can determine the amount of down rotation.

(190) As illustrated, application unit **2700** has two degrees for biasing fluid arms **2720***a*, **2720***b* outward and down. In another embodiment, such as when application unit **2700** is disposed proximate to the ground, down biasing is not needed. In this embodiment, bracket assembly **2730** (**2730***a*, **2730***b*) is pivotally connected to bracket base **2702**, bracket **2732** (**2732***a*, **2732***b*) is connected to bracket base **2702**, and bracket assembly **2740** (**2740***a*, **2740***b*) and member **2709** are not included (not shown).

(191) Optionally, disposed on the discharge end of fluid arms **2720***a*, **2720***b* is nozzle **3000**. In one embodiment, the rotation of fluid arms **2720***a*, **2720***b* outward towards the plant transverse to the direction of travel can be limited by stop **2721** (**2721***a*, **2721***b*), which is disposed on bracket base **2741** (**2741***a*, **2741***b*) to limit the rotation of bracket base **2731** (**2731***a*, **2731***b*). In another embodiment, a tab **2704** is disposed on the underside of bracket **2701**. A stop **2703**, which can have a U shape, is connected to bracket base **2702**, and which limits the rotation of application unit **2700** when tab **2704** contacts stop **2703**. In another embodiment, counteracting forces from bias element **2738** (**2738***a*, **2738***b*) can limit the rotation of bracket base **2731** (**2731***a*, **2731***b*) by being disposed over element **2734** (**2734***a*, **2734***b*) on a side of bracket **2733** (**2733***a*, **2733***b*) opposite to biasing element **2735** (**2735***a*, **2735***b*). In one embodiment illustrated in FIG. **27**C, nozzle **3022** does not

contact the plants, and the contact is made by ski **3030***a*, **3030***b*.
(192) Optionally, coulter assembly **2780** can be connected to vertical support **2799**. Coulter bracket arm **2781** is connected to vertical support **2799** at a first end, and at the opposite end, coulter **2782** is rotationally connected to coulter bracket arm **2781**. Optionally, an extension arm **2783** is connected to coulter bracket arm **2781** and disposed rearwardly along a direction of travel. A knife **2784** is disposed downwardly from extension arm **2783** to engage the ground posterior to coulter **2782**. Optionally, a fluid application line **2785** is disposed on knife **2784** for depositing fluid into the ground. As shown, application line **2785** is disposed on the posterior side of knife **2784** in the direction of travel, but application line **2785** can be disposed on any side of knife **2784**.
(193) Optionally, a cradle **2770** can be connected to bracket **2701** and disposed rearwardly in the direction of travel. Cradle **2770** has arms **2771***a*, **2771***b* and each has a receiver **2772***a*, **2772***b*, respectively (with an opening disposed upwards) for holding and retaining arms, respectively, when not in use, such as during transport. Arms **2771***a*, **2771***b* can be made as a unitary part or separate parts.
(194) In addition to any of the application units described above, at least one sprayer may be further included. An example of a sprayer can be found in US20170049043, which is incorporated herein by reference.
(195) In another embodiment, dampers can be included to dampen the motion of any member that contact plants. Examples of members include parts **922**, **982**, **1522**, **1528**, **1520**, **1720**, **3030**, and **3110**. In any of the embodiments illustrated in FIGS. **28**A to **28**D, the fluid application members are in fluid communication with a fluid source (not shown).
(196) Illustrated in FIG. **28**A, application unit **2891** includes a base **2812** with fluid application member **2805** (**2805***a*, **2805***b*) for dispensing fluid. Damper **2861** (**2861***a*, **2861***b*), such as a coil spring, is disposed about fluid application member **2805**. Plant contacting member **2851** (**2851***a*, **2851***b*) is connected to and extends from damper **2861** to contact plants. Plant contacting member **2851** can be a wire. Vibrations in plant contacting member **2851** are dampened by damper **2861**.
(197) Illustrated in FIG. **28**B, application unit **2892** includes base **2812** with fluid application member **2806** (**2806***a*, **2806***b*) for dispensing fluid. Connected to fluid application member **2806** is a plant contacting member **2830** (**2830***a*, **2830***b*) for extending to and contacting plants. Disposed between plant contacting member **2830** and fluid application member **2806** is a damper **2862** (**2862***a*, **2862***b*) for dampening vibrations caused by plant contacting member **2830** contacting plants. Examples of damper **2862** include, but are not limited to, shock absorber and dashpot.
(198) Illustrated in FIG. **28**C, application unit **2893** includes a base **2812** with fluid application member **2807** (**2807***a*, **2807***b*) that extend from base **2812** to deliver fluid and contact plants. Connected to base **2812** and disposed to contact fluid application member **2807** is damper **2862** (**2862***a*, **2862***b*).
(199) Illustrated in FIG. **28**D, application unit **2894** includes a base **2812** and linkage member **2820** (**2820***a*, **2820***b*) for conveying fluid. Connected to linkage member **2820** is fluid application member **2822** (**2822***a*, **2822***b*). Fluid application member can be a hose. Attached to fluid application member **2822** and extending to and contacting plants is plant contacting member **2851** (**2851***a*, **2851***b*). Plant contacting member **2851** can be a wire or other flexible material. Connected to base **2812** and disposed to contact plant contacting member **2851** is damper **2862** (**2862***a*, **2862***b*).
(200) In another embodiment, with or without the damper, any of members that contact plants (such as **922**, **982**, **1522**, **1528**, **1520**, **1720**, **2851**, **2830**, **2807**, **3030**, **3110**) have a length such that the member is in contact with at least two plants. Being in contact with at least two plants minimizes the outward flexing of the member.
(201) While not shown, it is understood that any application unit described herein is in fluid communication with a source (e.g., tank **250**) containing an application (e.g., fluid application, crop inputs such as fertilizer, fungicide, herbicide or insecticide).

(202) Any of the following examples can be combined into a single embodiment or these examples can be separate embodiments. In one example, a fluid applicator (e.g., application unit **800**, **850**, **900**, **1300**, **1350**, **1700**, **1750**, **1752**, **1780**, **2891-2894**, etc.) for applying fluid to plants in rows in a field comprises a frame, a coulter connected to the frame and disposed to open a trench between the rows of plants, and at least one application member (e.g., **830**, **920**, **1520**, **1720**, **2805-2807**, etc.).
(203) In another example, the at least one application member comprises a first application member and a second application member.
(204) In another example, the fluid applicator of further comprises a fluid application line connected to the frame and disposed behind the coulter in a direction of travel to apply fluid to the trench.
(205) In another example, the coulter has coulter frame, and further comprising an extending frame connected to the coulter frame and disposed to extend behind the coulter in a direction of travel, and a knife downwardly disposed from the extending frame and disposed to contact ground.
(206) In another example, the fluid applicator further comprises a fluid application line connected to the knife to apply fluid in the trench.
(207) In another example, the frame is a toolbar.
(208) In another example, the frame is a boom.
(209) In another example, the at least one application member is connected to the frame.
(210) In another example, the coulter has coulter frame, and the at least one application member is connected to the coulter frame.
(211) In another example, the fluid applicator further comprises a closer connected to the coulter and disposed to close the trench.
(212) In one example, an application unit for applying fluids to plants in rows in a field comprises a frame, an opening disc connected to the frame and disposed to open a trench between the rows of plants, and at least one application member connected to the frame or to the coulter and disposed to apply fluid to a rhizosphere of the plants.
(213) In another example, the at least one application member comprises a first application member and a second application member.
(214) In another example, the application unit further comprises a fluid application line connected to the frame and disposed behind the opening disc in a direction of travel to apply fluid to the trench.
(215) In another example, the opening disc has a frame, and the application unit further comprises an extending frame connected to the frame and disposed to extend behind the opening disc in a direction of travel, and a knife downwardly disposed from the extending frame and disposed to contact ground.
(216) In one example, a fluid applicator, comprises a base disposed between plants in adjacent rows, at least one application member connected to the base and disposed to apply fluid to the plants in a rhizosphere of the plants, and a nozzle (e.g., **1530**, **1630**, **3000**, etc.) disposed at an end of the application member for dispensing fluid from the application member to the plants in the rhizosphere of the plants.
(217) In another example, the at least one application member comprises a first application member with a first nozzle and a second application member with a second nozzle.
(218) In another example, the nozzle further comprises a wire extending from the nozzle and disposed to contact the plant.
(219) In another example, the nozzle further comprises a ski disposed under the nozzle.
(220) In another example, the nozzle further comprises an aerator.
(221) In another example, the aerator is disposed on a bottom of the nozzle.
(222) It is to be understood that the above description is intended to be illustrative, and not restrictive. Many other embodiments will be apparent to those of skill in the art upon reading and understanding the above description. The scope of the disclosure should, therefore, be determined

with reference to the appended claims, along with the full scope of equivalents to which such claims are entitled.

Claims

1. A fluid applicator, comprising: a base disposed between plants in adjacent rows; at least one application member connected to the base; and a nozzle housing that includes a nozzle and a fluid outlet disposed in the nozzle, wherein the nozzle housing is disposed at an end of the application member to dispense fluid from the application member to the rhizosphere of the plants; wherein the rhizosphere is a base region of the plants where the plants emerge from the soil, wherein the application member is biased with one of a fluid system, a pneumatic system, or a hydraulic system laterally outward from the base to rotate from a first inner position in a middle of a row between plants in adjacent rows for no fluid application to a second laterally outward position to apply fluid to the rhizosphere of a row of plants.
2. The fluid applicator of claim 1, wherein the at least one application member comprises a first application member with a first nozzle and a second application member with a second nozzle to apply fluid to the rhizosphere a target region of the plants including a root ball, crown, crown root or mesocotyl.
3. The fluid applicator of claim 1, wherein the nozzle housing further comprises a wire extending from the nozzle housing and disposed to contact one or more plants of the row of plants.
4. The fluid applicator of claim 1, wherein the nozzle housing further comprises a ski disposed under the nozzle housing for engaging a ground surface to keep the fluid outlet of the nozzle from contacting the ground surface.
5. The fluid applicator of claim 1, wherein the nozzle is configured to dispense pressurized fluid from the fluid outlet to the rhizosphere of the plants.