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(54) **SEED METERING ASSEMBLY FOR A FARM IMPLMENT**

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(71) Applicant: **CNH Canada, Ltd.**, Saskatoon (CA)

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(72) Inventor: **Terrance A. Friggstad**, Grasswood (CA)

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(73) Assignee: **CNH Canada, Ltd.**, Saskatoon (CA)

(57) **ABSTRACT**

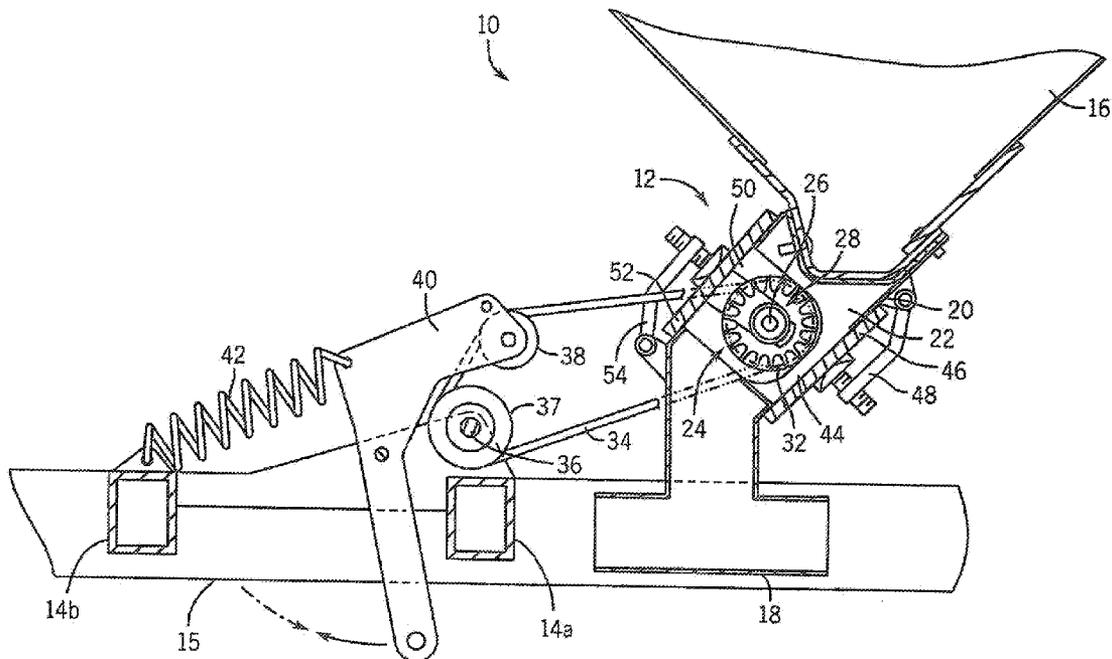
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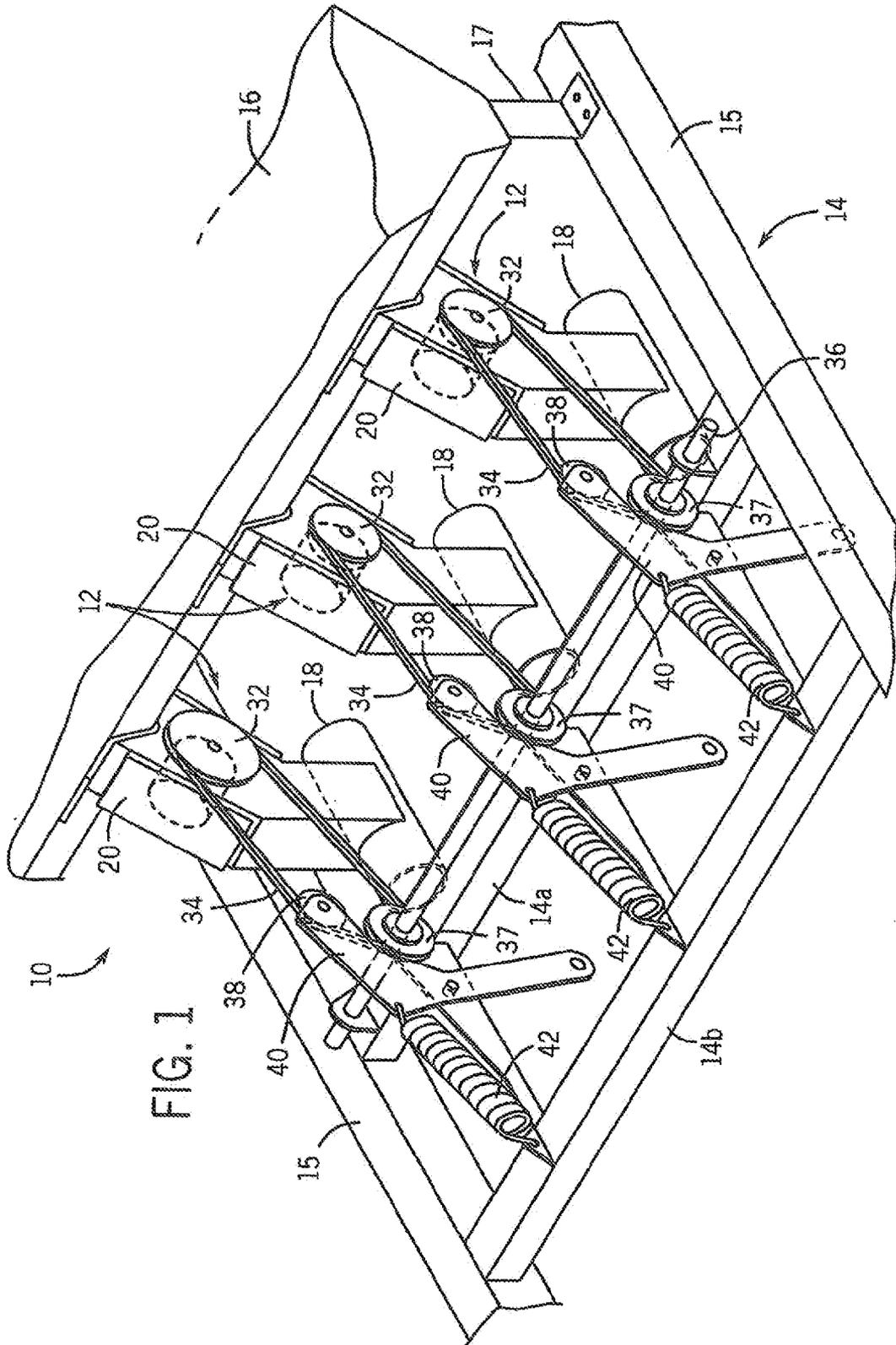
The present invention is directed to a seed metering assembly comprised of a set of stand-alone modular seed metering units. Each seed metering unit is selectively driven by a common drive member, such as a drive shaft. When a seed metering unit is engaged with the drive member, the unit will meter granular material. On the other hand, when the seed metering unit is not engaged with the drive member, the metering unit will not meter granular material. Hence, the present invention provides a seed metering apparatus in which the number of seed metering units can be scaled to match the number of distribution headers of a seeding implement.

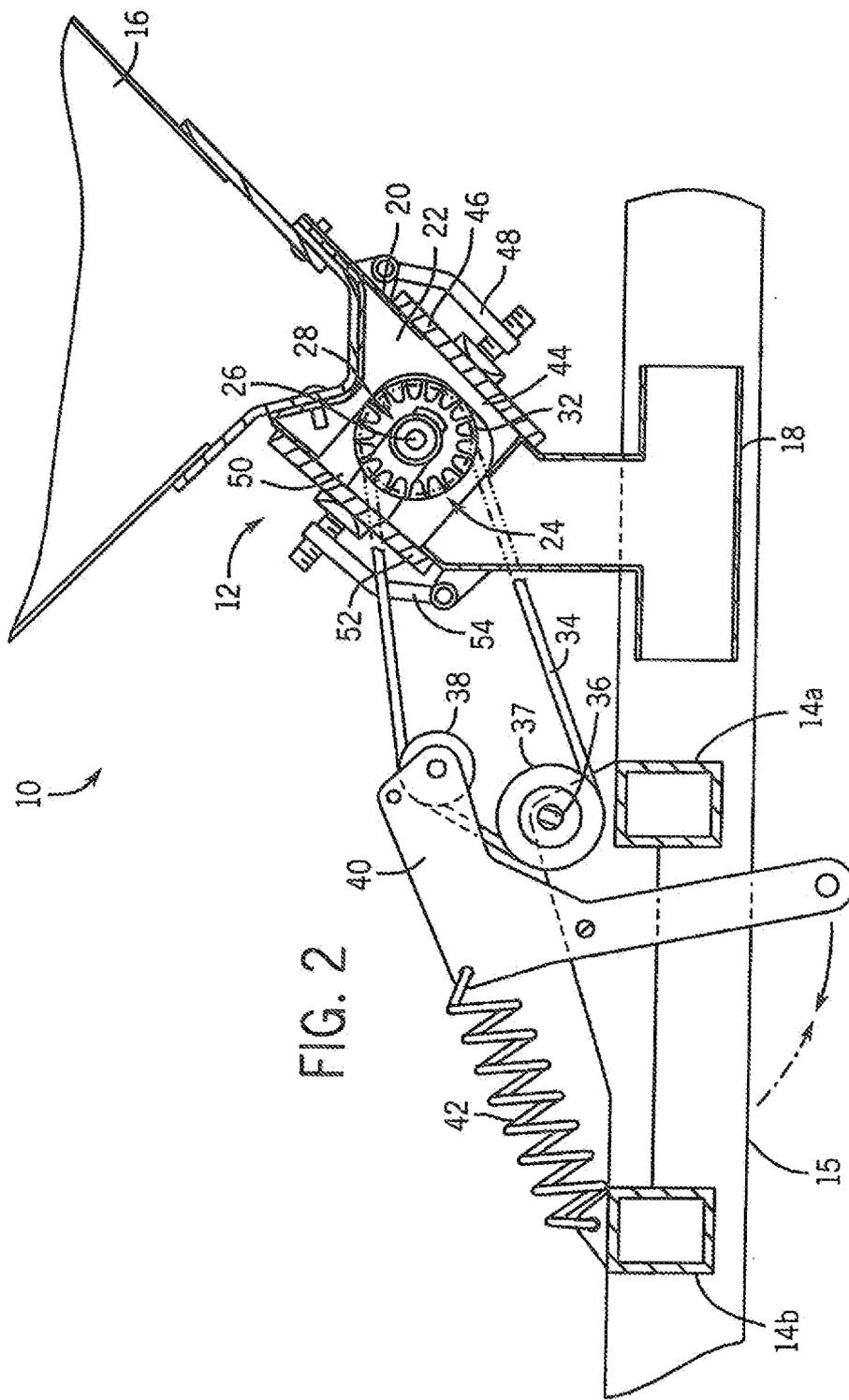
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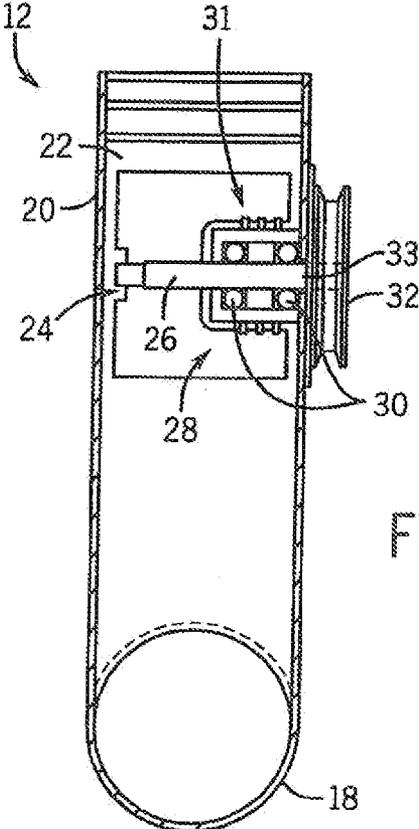


FIG. 3

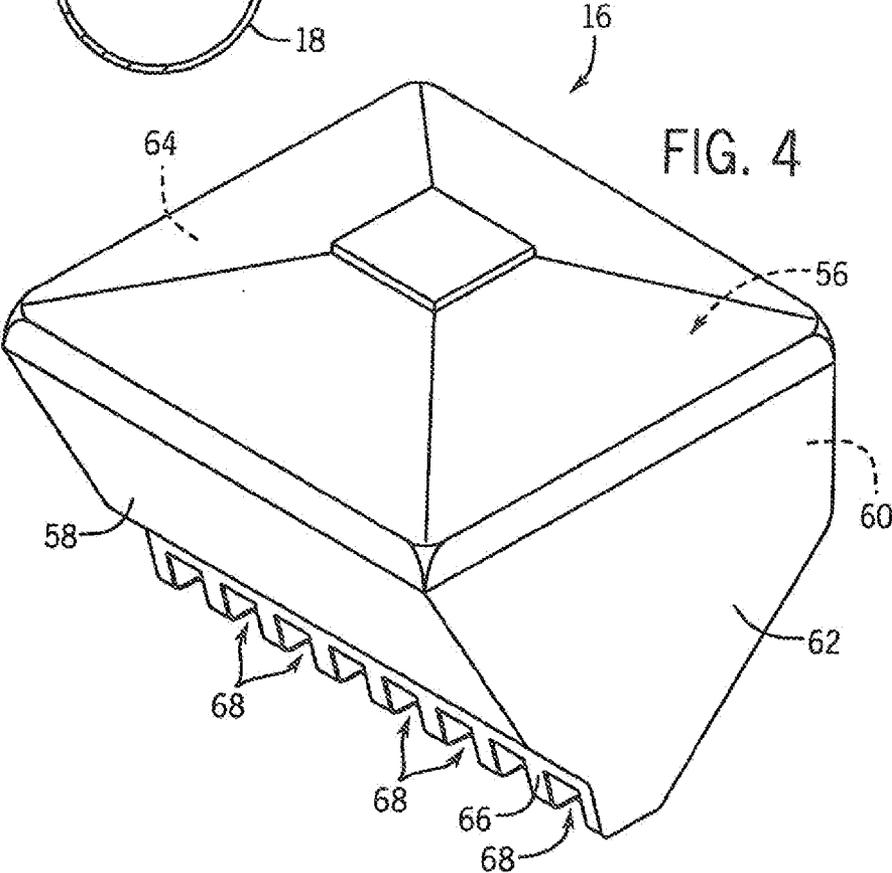
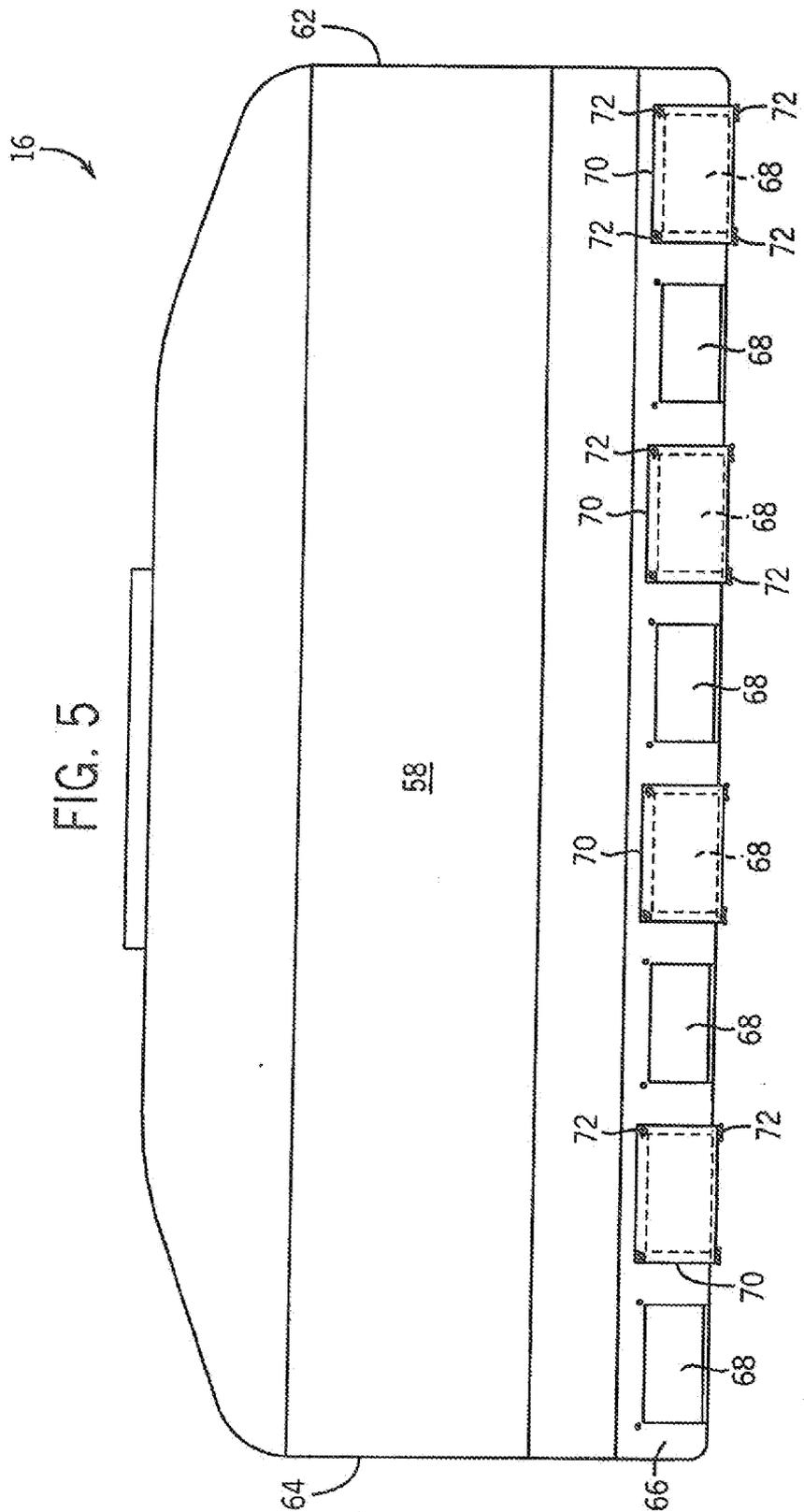


FIG. 4



**SEED METERING ASSEMBLY FOR A FARM IMPLEMENT**

**BACKGROUND OF THE INVENTION**

**[0001]** The present invention relates to farm implements and, more particularly, to a seed metering cassette for a seeding implement, such as an air seeder.

**[0002]** Air seeders are commonly towed by tractors to apply seed, fertilizer, or micro-nutrients or any granular product to a field. For purposes of this application “seeding” shall include the application or deposition of any granular or particulate material onto a field, and “seed” shall include seed, fertilizer, micronutrients, or any other granular material that may be applied onto a planting surface, farm field, seedbed, and the like. It is generally advantageous to tow an air seeder in combination with a tilling implement, one behind the other, to place the seed and fertilizer under the surface of the soil. An air seeder has as its central component a wheeled seed cart which comprises one or more frame-mounted seed tanks for holding product, generally seed or fertilizer or both. Air seeders also generally include a volumetric metering system operable to measure a fixed volume of seed per unit of linear distance and a pneumatic distribution system for delivering the product from the tank to the soil.

**[0003]** The volumetric metering system is configured for distribution of product from the tank to the distribution headers of the seed tubes. The metering system typically includes a meter roller assembly employing augers or fluted cylinders (meter rollers) situated in a meter box assembly secured below the tank.

**[0004]** Typically the meter box will have a series of outlets known as runs that each leads to the distribution lines of the pneumatic distribution system. The pneumatic distribution system generally includes an air stream operable to carry product metered by the meter roller assembly through the distribution lines to a series of secondary distribution manifolds (“headers”), which in turn distribute product to a group of ground openers mounted on the seeding implement operable to place seed in the ground. The ground openers are configured to evenly deliver the product to the span of ground (the “seedbed”) acted upon by the seeding implement.

**[0005]** To reduce manufacturing costs and eliminate consumer confusion is customizing an air seeder, most manufacturers offer a seed metering assembly in which the meter box and the fluted meter roller that are sized to meter granular material to a preset number of secondary headers. One of the drawbacks of such a construction is that not all implements require or have the preset number of secondary headers. For those implements having fewer secondary headers, sections of the seed metering assembly must be capped off. The result is that the consumer is required to purchase a seed metering assembly that may be larger than the consumer requires.

**[0006]** Additionally, for some implements, there can be some inconsistency in the number of outlets of the secondary headers. This inconsistency is generally the result of the implement having a particular frame configuration that may be required to achieve a particular transport configuration. Since the meter roller meters granular material to each of the secondary headers at the same metering rate, the amount of granular material per outlet will be higher for those secondary headers having a fewer number of outlets. As a result, the seedbed serviced by the ground opener units that are fed by the headers having fewer outlets will be over-seeded compared to the seedbed serviced by the other ground opener

units. This discrepancy in the application of granular material, which heretofore has been generally ignored, can ultimately lead to inconsistent seeding and thus inconsistent per row crop yields.

**SUMMARY OF THE INVENTION**

**[0007]** The present invention is directed to a modular seed metering assembly or unit in which several such modular units can be used to build a seed metering apparatus that is matched to a particular implement. Each modular assembly is a stand-alone unit that can be controlled to meter granular material at a metering speed that is independent of the metering speed of the other units of the seed metering apparatus. Each seed metering unit is selectively driven by a common drive member, such as a drive shaft. Thus, when a seed metering unit is engaged with the drive member, the unit will meter granular material. On the other hand, when the seed metering unit is not engaged with the drive member, the metering unit will not meter granular material. Hence, the present invention also provides a seed metering apparatus that provides effective sectional control. Moreover, when an engaged seed metering unit is disengaged, the response time is nearly instantaneous. Thus, metering by the disengaged seed metering unit ceases nearly immediately.

**[0008]** Accordingly, in one aspect of the invention, a seed metering apparatus is provided that is capable of metering measured amounts of granular material to a number of secondary headers using a series of modular seed metering units that can be independently controlled to provide sectional control during seeding.

**[0009]** In a further aspect, each metering unit can be caused to run faster or slower than other metering units of the metering apparatus to provide additional control in the metering of seed, fertilizer or other granular material.

**[0010]** In accordance with another aspect of the invention, a modular seed metering limit or seed metering cassette is provided that allows a seed metering unit to be added or removed from a seed metering apparatus as a stand-alone component. In this regard, the needed number of seed metering units for a given air seeder can be achieved by stacking together modular units. As such, the present invention allows an air seeder to be built using modular components rather than using a single, fixed length meter roller.

**[0011]** It is therefore an object of the invention to provide a seed metering apparatus with sectional control and, more particularly, sectional control with a quick response time.

**[0012]** It is another object of the invention to provide a cassette-based seed metering unit in which multiple such units could be arranged together to form a seed metering apparatus.

**[0013]** Other objects, features, aspects, and advantages of the invention will become apparent to those skilled in the art from the following detailed description and accompanying drawings. It should be understood, however, that the detailed description and specific examples, while indicating preferred embodiments of the present invention, are given by way of illustration and not of limitation. Many changes and modifications may be made within the scope of the present invention without departing from the spirit thereof, and the invention includes all such modifications.

**BRIEF DESCRIPTION OF THE FIGURES**

**[0014]** Preferred exemplary embodiments of the invention are illustrated in the accompanying drawings in which like reference numerals represent like parts throughout.

[0015] In the drawings:

[0016] FIG. 1 is an isometric view of a seed metering apparatus for use with an air seeder according to one embodiment of the present invention;

[0017] FIG. 2 is a side elevation view of the seed metering apparatus of FIG. 1;

[0018] FIG. 3 is a rear view of one seed metering unit of the seed metering apparatus of FIG. 1;

[0019] and

[0020] FIGS. 4-5 are views of a bulk fill hopper of the seed metering apparatus of FIG. 1 according to another aspect of the invention.

#### DETAILED DESCRIPTION

[0021] Turning now to FIG. 1, a seed metering apparatus 10 for an air seeder (not shown) includes a series of seed metering units 12 each mounted to a seeder frame 14, e.g., frame crossbar 14a, adjacently below a hopper 16. In one embodiment, the frame 14 includes the aforementioned crossbar 14a and an upland crossbar 14b that are interconnected between a pair of parallel rails 15. Each seed metering unit 12 is designed to meter granular material, e.g., seed or fertilizer, from the hopper 16 to one or more delivery conduits 18. The hopper 16 is mounted to the parallel rails 15 in a conventional manner, i.e., by mounts 17. It will thus be appreciated that the seed metering units 12 are supported at one end by a connection to crossbar 14a and supported at an opposite end by hopper 16.

[0022] As will be described more fully below, each seed metering unit 12 is a self-contained, modular, and individual assembly. In this regard, the number of seed metering units for a given seed metering apparatus may vary from that shown in figures. Moreover, the modularity of the seed metering units 12 allows the number of seed metering units to be matched to the number of secondary headers (not shown) of the air seeder. Further, the present invention allows seed metering units to be added to a given air seeder as needed. Additionally, as will be described, each metering unit can be independently controlled. Thus, each metering unit can meter granular material at a speed that is independent of the meter rates of other metering units. This is particularly advantageous for air seeders having secondary headers with differing number of outlets.

[0023] With additional reference to FIGS. 2 and 3, each metering unit 12 has a bulkhead 20 that defines a cavity 22 containing a meter roller assembly 24. The meter roller assembly 24 includes a fluted rotor 26 that is rotatably mounted to bulkhead 20 by a bearing assembly 28, which includes a bearing 30. O-rings 31 provide sealing of the rotor 26 in the bulkhead 20. As known in the art, when the rotor 26 rotates, the fluted rotor 26 captures granular material as it falls from the hopper 16 and passes the captured granular material to the delivery conduits associated with the seed metering unit 12.

[0024] Each fluted rotor 26 further has a pulley 32 that is mounted to, or integrally formed with, the rotor 26. In the illustrated example, an end of the rotor 26 passes through an opening 33 formed in the bulkhead. The pulley 32 is attached to the exposed portion of the rotor 26. Each pulley 32 is caused to rotate by a drive belt 34 that is entrained about the pulley 32 and a drive shaft 36. As shown particularly in FIG. 1, a series of pulleys 37 are mounted to the drive shaft 36 and thus rotate with rotation of the drive shaft 36. Each drive belt is each entrained about a respective pulley 32 and a respective

drive pulley 37. In this regard, a single and common drive shaft 36 is used to cause rotation of the fluted rotors 26. In a preferred embodiment, drive belts 34 are each V-belts, but it is understood that other types of elongated members could be used, such as chains, links, cable, and the like.

[0025] When drive shaft 36 rotates, the drive belts 34 are caused to translate around the drive shaft and their respective pulleys 32 to cause rotation of the fluted rotor 26 and ultimately metering of granular material passed from the hopper 16 to the seed metering unit 12. The present invention, however, provides sectional control of the seeding process. In this regard, each metering unit 12 also includes an idler roller 38 that is mounted to a bell crank 40. The bell cranks 40 are pivotably mounted to the seeder frame 14 in a conventional manner. In addition to being entrained about pulley 32 and drive shaft 36, each drive belt 34 is also entrained about a respective idler roller or pulley 38. Each idler roller 38 is designed to add or remove tension to its associated drive belt 34. When the drive belt 34 is tensioned, rotation of the drive shaft 36 will cause translation of the drive belt 34 and thus rotation of the pulley 32. On the other hand, when there is sufficient slack in the drive belt, the drive belt 34 will be loosely entrained about the drive shaft 36 and, as a result, rotation of the drive shaft 36 will not cause translation of the drive belt 34. Accordingly, when there is sufficient slack in the drive belt 34, rotation of the drive shaft 36 will not cause rotation of the fluted rotor 26. It will thus be appreciated that sectional control can be achieved by selectively disengaging a selected seed metering unit from tensioned engagement with the drive shaft 36.

[0026] Movement of the idler roller 38 is controlled by a respective bell crank 40. In this regard, the bell crank 40 is movable between an engaged position and a disengaged position. A tensioning spring 42 is interconnected with the seeder frame 14, e.g., crossbar 14b, and the bell crank 40 to bias the bell crank 40, and thus the drive belt 34, in the engaged position. In a preferred embodiment, each bell crank 40 is linked to a drive input (not shown) that is operative to move the bell crank 40 between the engaged and disengaged positions. The drive input may be any known or to be developed input device. For example, a hydraulic, pneumatic, mechanical, or electrical circuit could be used to move the bell crank 40 between the engaged and disengaged positions. Moreover, it is contemplated that each input device may be controlled via an operator input or controlled automatically, such as by a GPS-based control.

[0027] In one preferred embodiment, a single input device is used to simultaneously move a set of bell cranks 40 to effectuate engagement/disengagement of a set of seed metering units 12. This "tying" of multiple seed metering units 12 to a single input device allows all of the seed metering units 12 feeding granular material to a given secondary header to be started or stopped at the same time. While the seed metering units can be grouped together and thus controlled by a shared input device, the present invention is not so limited. Each seed metering unit, or a given group of seed metering units, can be selectively disengaged from the common drive shaft to effectively stop the metering by the selected seed metering units. It will thus be appreciated that the invention provides sectional control without mechanical gates or similar devices.

[0028] Additionally, the modularity of the seed metering units and the independent coupling of each seed metering unit to the drive shaft effectively provides a cartridge or cassette that can be added on an as-needed basis to a given air seeder.

Moreover, because each seed metering unit is a separate stand-alone cartridge, metering units will different characteristics can be used on a single air seeder. For example, a larger pulley 32 could be used for one seed metering unit to provide metering at a slower rate and a smaller pulley 32 could be used for another seed metering unit to provide metering at a faster rate. This modularity could be particularly advantageous in instances in which it is desirable to meter seed and fertilizer at different rates.

[0029] Referring briefly again to FIG. 2, the bulkhead 20, in one preferred embodiment, has a pair of service openings. One service opening is a drain port 44 that is formed in the lower end of the bulkhead 20. The drain port 44, when opened, allows granular material to be drained from the hopper. The drain port 44 is selectively opened and closed by a drain door or panel 46 that is pivotably mounted to the hopper 16 by linkage 48.

[0030] Generally opposite the drain port 44 is an access opening 50. The access opening 50 is sized to allow removal of the rotor 26 when disconnected from the rotor bearing assembly 28. The access opening 50 is opened and closed by an access panel 52 that is pivotably mounted to a lower end of the bulkhead 20 by linkage 54.

[0031] Referring now to FIGS. 4-5, hopper 16 has an internal volume 56 defined by a front panel 58, rear panel 60, and side panels 62, 64. The hopper 16 further has a lower panel 66. The panels are interconnected in a known manner or could be integrally formed as a single unit. In one preferred embodiment, the lower panel 66 includes a series of openings 68. The number of openings 68 is matched to the number of seed metering units 12. It will thus be appreciated that the invention provides a hopper 16 that can be quickly serviced to provide a number of discharge openings matched to the number of seed metering units. In one embodiment, each opening 68 can be closed as needed by a cover plate 70 which is secured to the lower panel 66 using conventional fasteners, such as wing nuts 72. Alternately, it is contemplated that the lower panel has linearly spaced knockouts. When a knockout is removed, a corresponding opening in the lower panel is exposed. In one embodiment, the knockouts cannot be reattached to the lower panel; although, other embodiments may have re-attachable knockouts. Additionally, it is contemplated that other types of devices may be used to selectively form discharge openings in the lower panel, such as slidable or removable doors, louvers, and the like.

[0032] While a drive belt and pulley arrangement is shown in the figures and has been described above, it is understood that other types of arrangements could be used, such as gears, clutches, individual electric motors or hydraulic motors, and the like.

[0033] From the foregoing it will be appreciated that the present invention provides a seed metering apparatus capable of metering measured amounts of granular material to a number of secondary headers using a series of modular seed metering units that can be independently controlled to provide sectional control during seeding. Each metering unit can

be caused to rim faster or slower than other metering units of the metering apparatus. Moreover, the modularity of the present invention allows each seed metering unit to be added or removed from the seed metering apparatus as a stand-alone cartridge or cassette. It will also be appreciated that the present invention provides sectional control with a quickened response time. When the drive belt for a given seed metering unit is loosened as a result of its bell crank being moved to the disengaged position, the meter roller for the seed metering unit will stop nearly instantaneously. As such, the present invention avoids the shut-off lag times typically associated with sectional control.

[0034] Many changes and modifications could be made to the invention without departing from the spirit thereof. The scope of these changes will become apparent from the appended claims.

1-10. (canceled)

11. A seed metering assembly for a farm implement having a hopper sized to hold a volume of particulate material and having a discharge end for passing of particulate material to a set delivery runs flow coupled to a plurality of distribution headers, the assembly comprising:

a plurality of seed metering cassettes individually mounted adjacent the discharge end of the hopper with each seed metering cassette in fluid communication with an internal volume of the hopper and at least one delivery run, each seed metering cassette configured to be independently driven by a common drive shaft, and wherein the number of seed metering cassettes is matched to the plurality of distribution headers of the farm implement.

12. (canceled)

13. The seed metering assembly of claim 11 wherein each seed metering cassette further includes an idler wheel that is movable to selectively tension or slacken the drive cable about the drive shaft.

14. (canceled)

15. The seed metering assembly of claim 11 wherein each drive cable is a V-belt.

16. The seed metering assembly of claim 11 wherein each seed metering housing further includes an access opening that is selectively opened and closed by an access panel, and wherein the metering roller is removable from the seed metering housing when the access opening is open.

17. The seed metering assembly of claim 15 wherein each seed metering housing further includes a drain port and a drain panel that selectively opens and closes the drain port.

18. The seed metering assembly of claim 11 wherein the seed metering roller is a fluted metering roller.

19. (canceled)

20. The method of claim 18 further comprising interfacing each of the modular seed metering units with a drive member that causes a seed metering units to meter granular material from the hopper when the seed metering unit is drivingly engaged with the drive member.

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