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(54) **COMPACT MANURE INCORPORATION SYSTEM**

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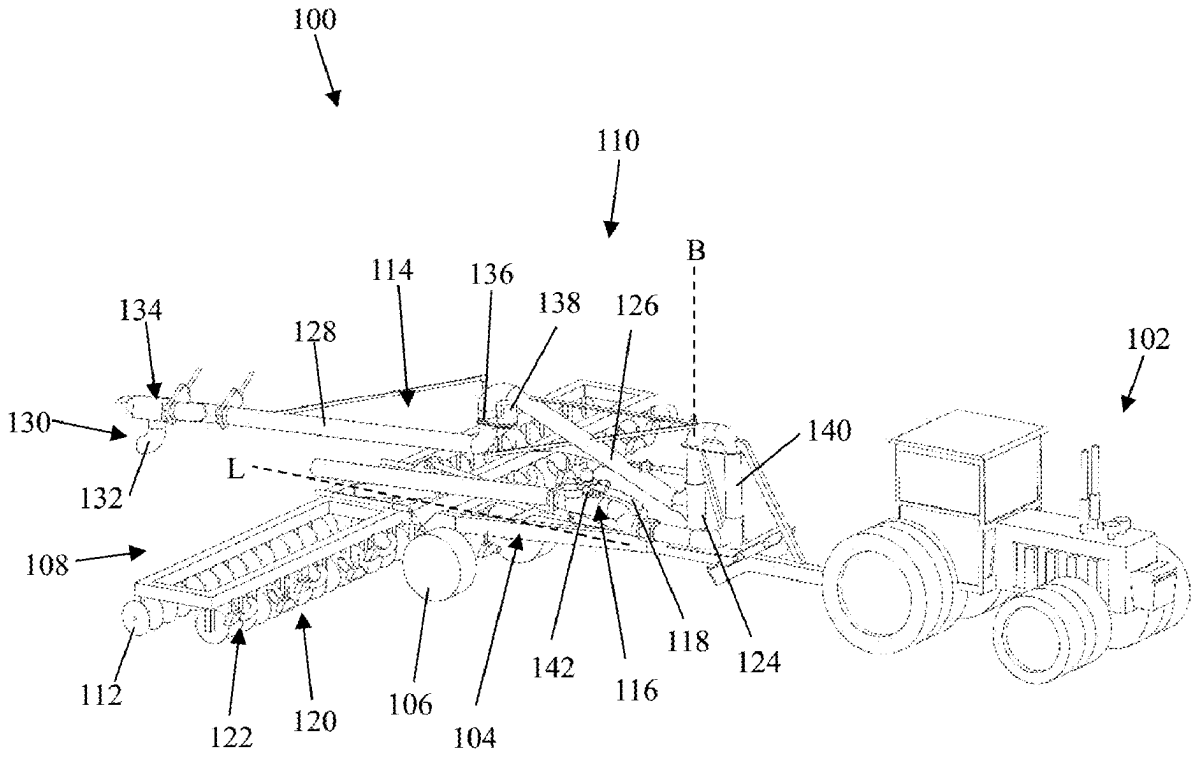
(57) **ABSTRACT**

Manure incorporation systems are disclosed including a wheeled frame connected to a toolbar and supporting a manure distribution system. The toolbar can include a plurality of discs, sweeps, coulters, points, and the like, organized in multiple rows and sections, and the manure distribution system can include a swing pipe, a distributor, a plurality of distribution hoses, a plurality of injectors, and a plurality of manure splash hoods or pans, where such components combine to provide a more compact manure incorporation system configuration for storage and transport. Methods of using manure incorporation systems are disclosed.



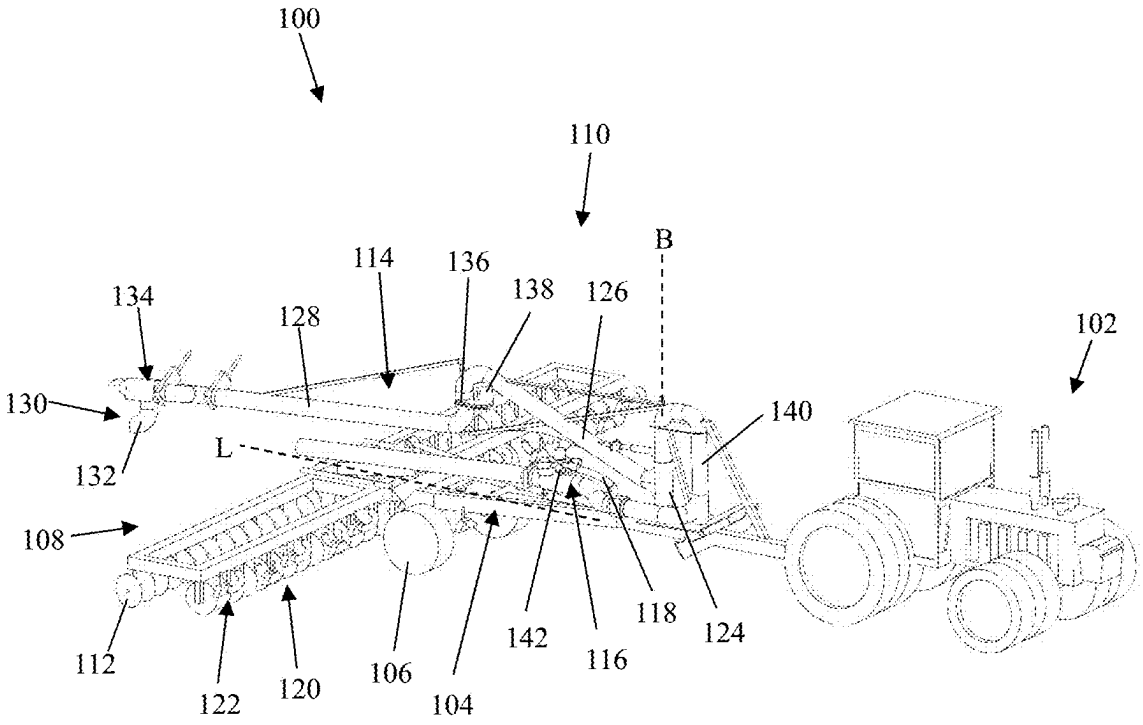

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FIG. 1

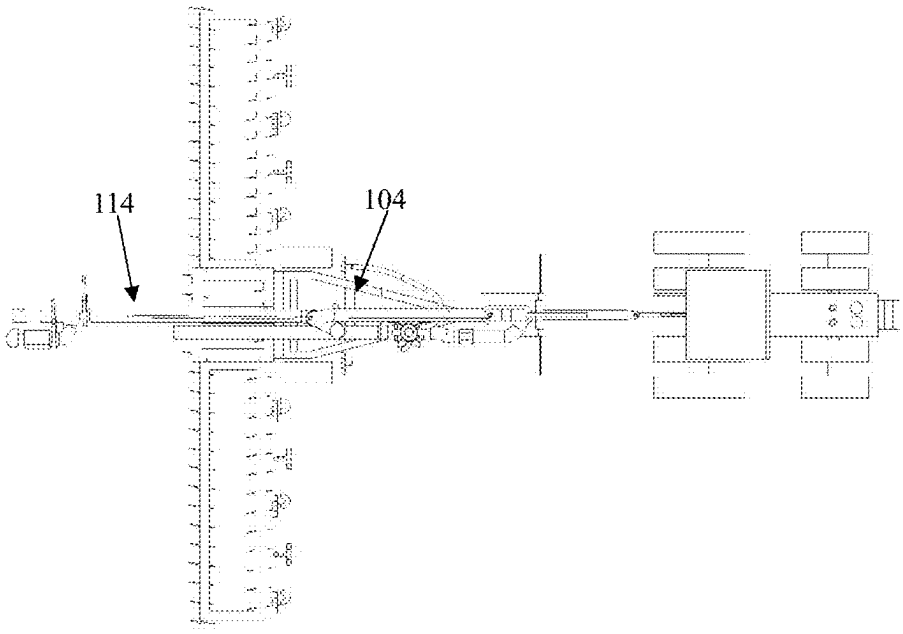


FIG. 2

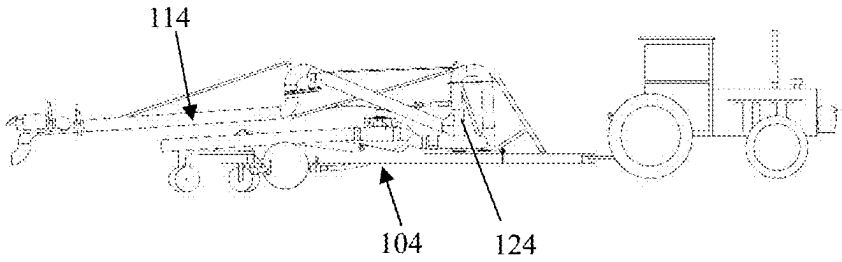


FIG. 3

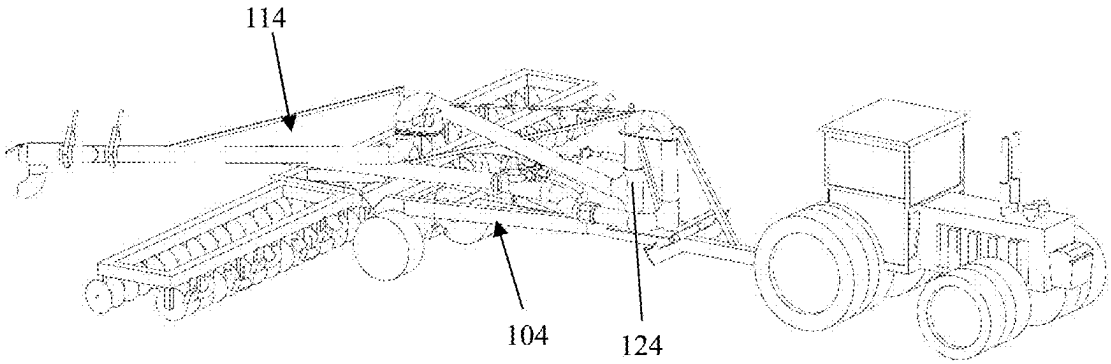


FIG. 4

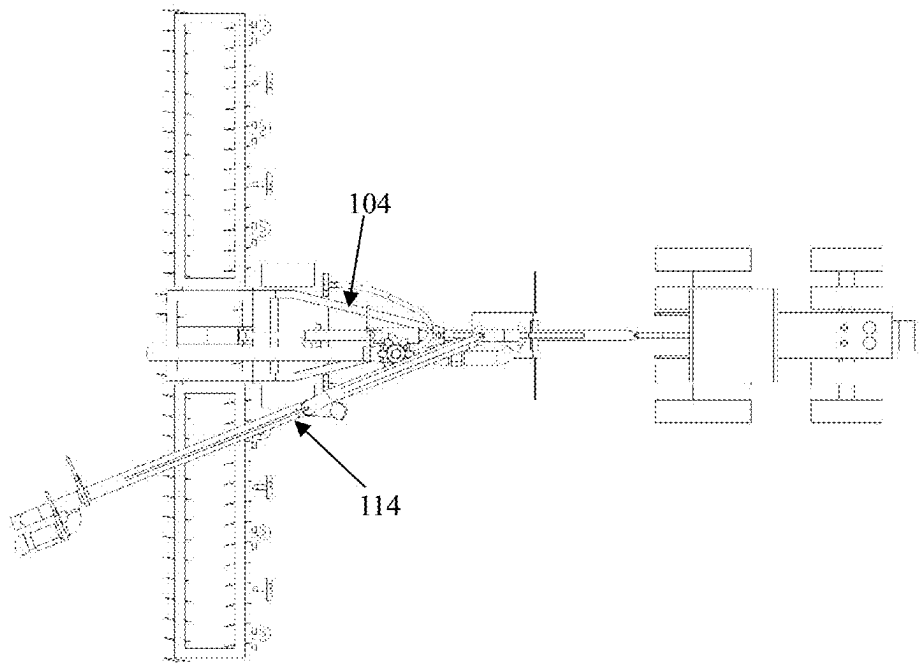


FIG. 5

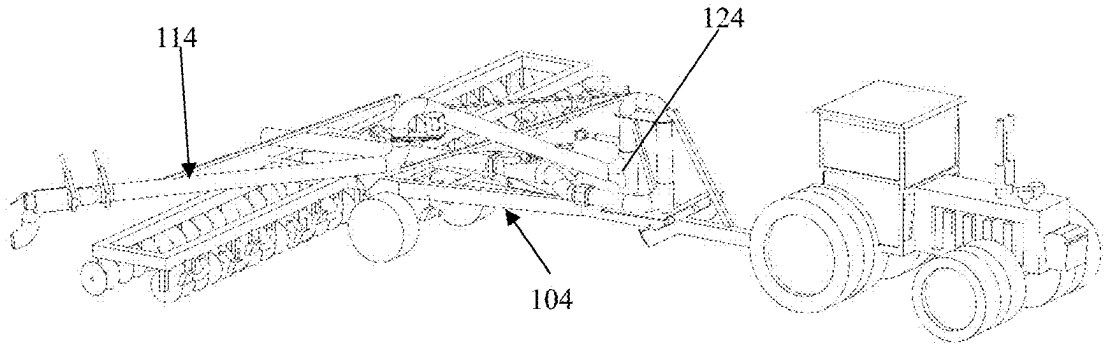


FIG. 6

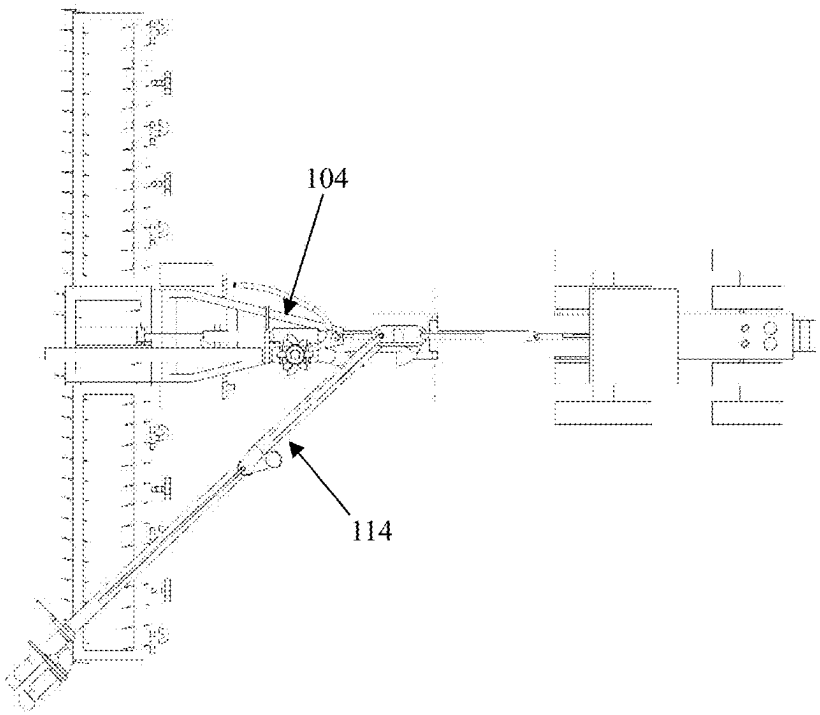


FIG. 7

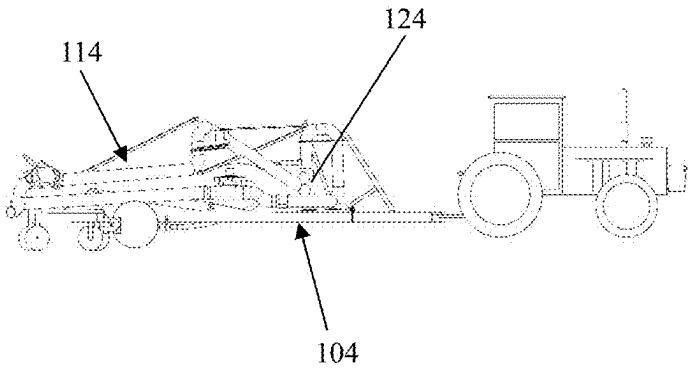


FIG. 8

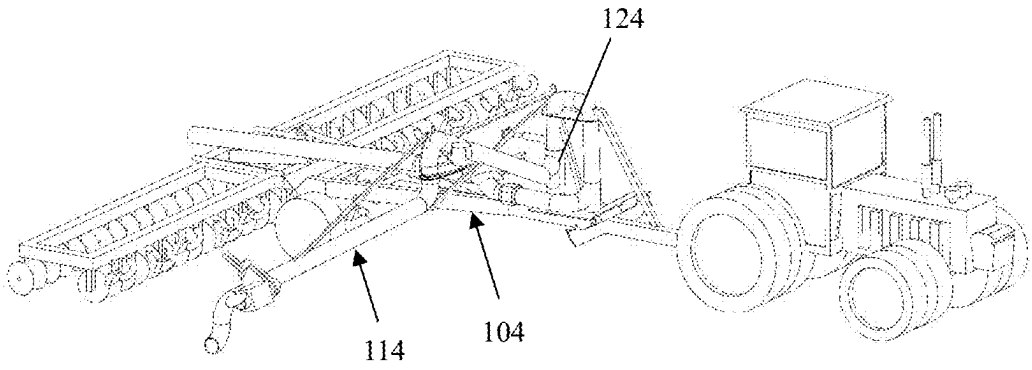


FIG. 9

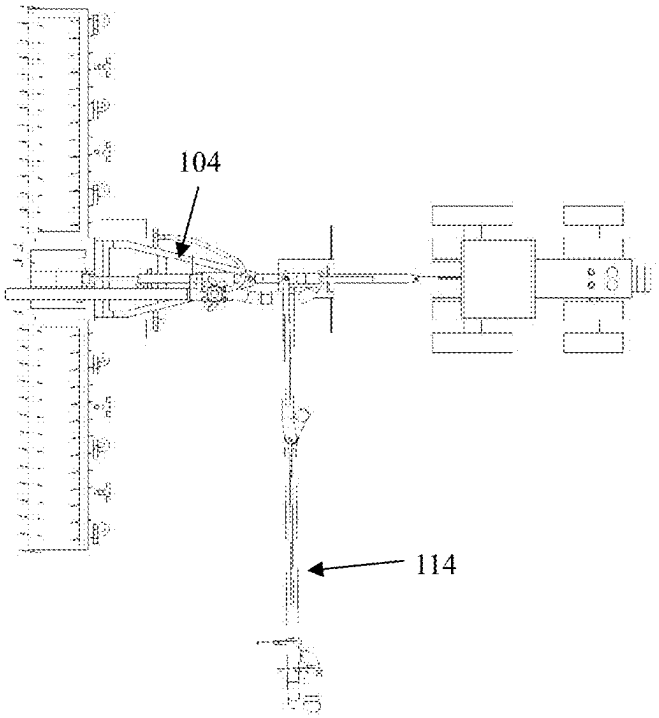


FIG. 10

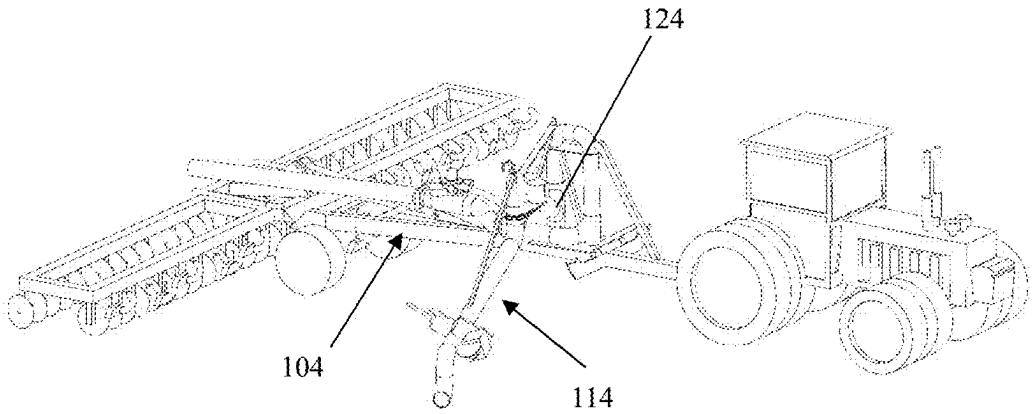


FIG. 11

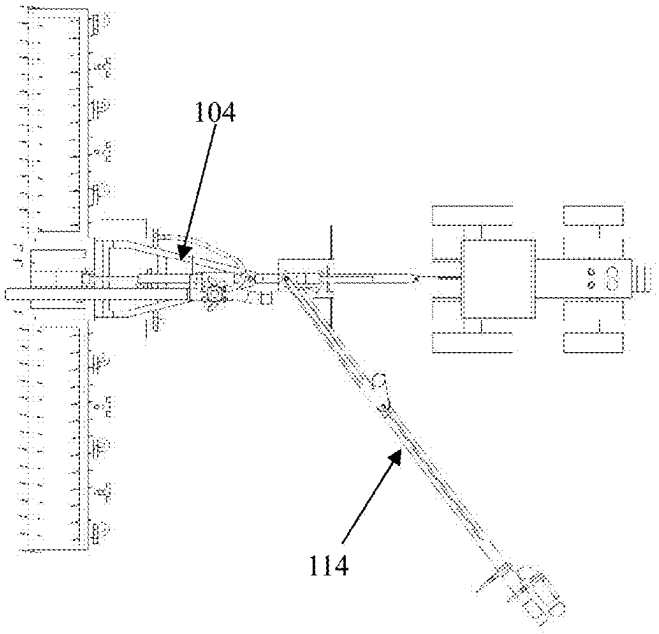


FIG. 12

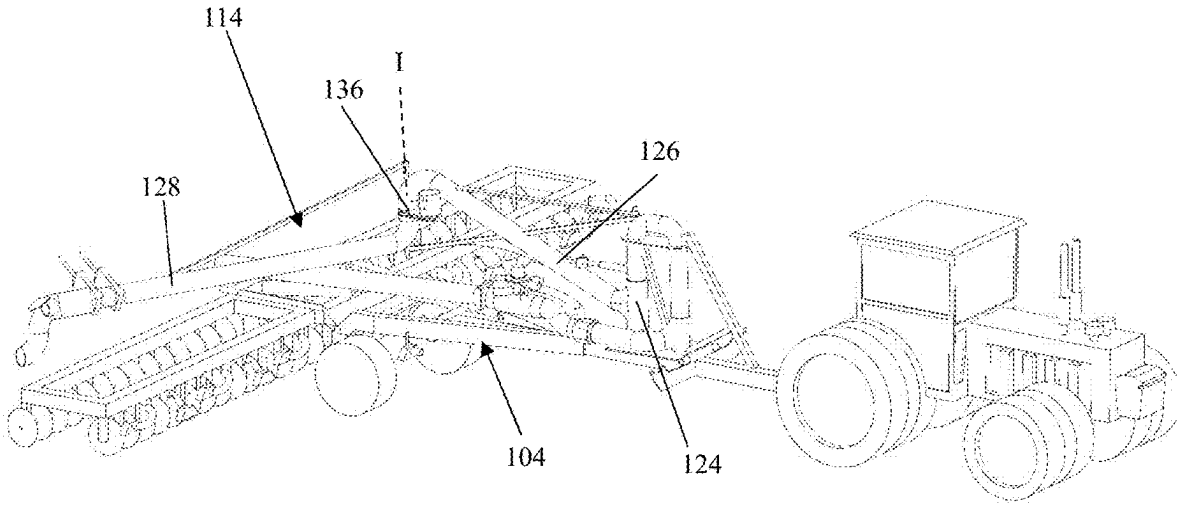


FIG. 13

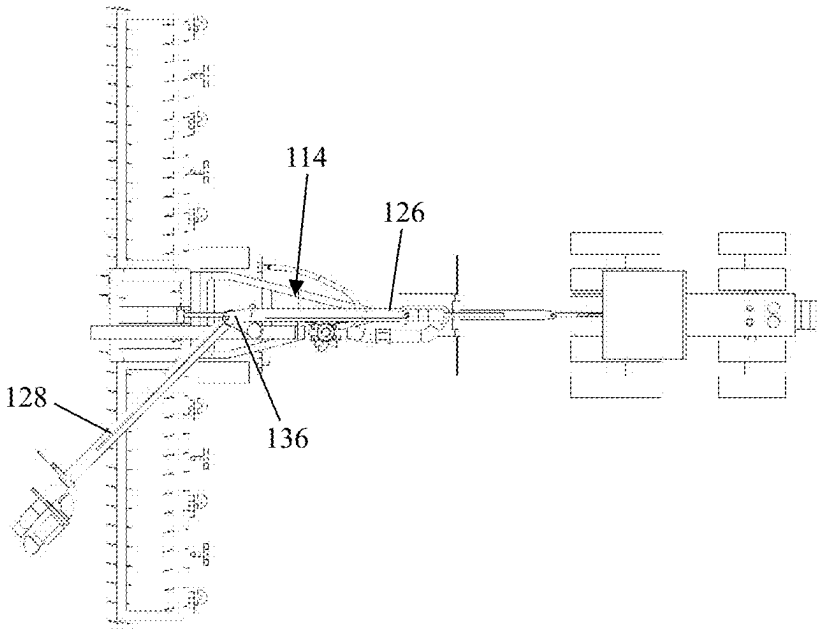


FIG. 14

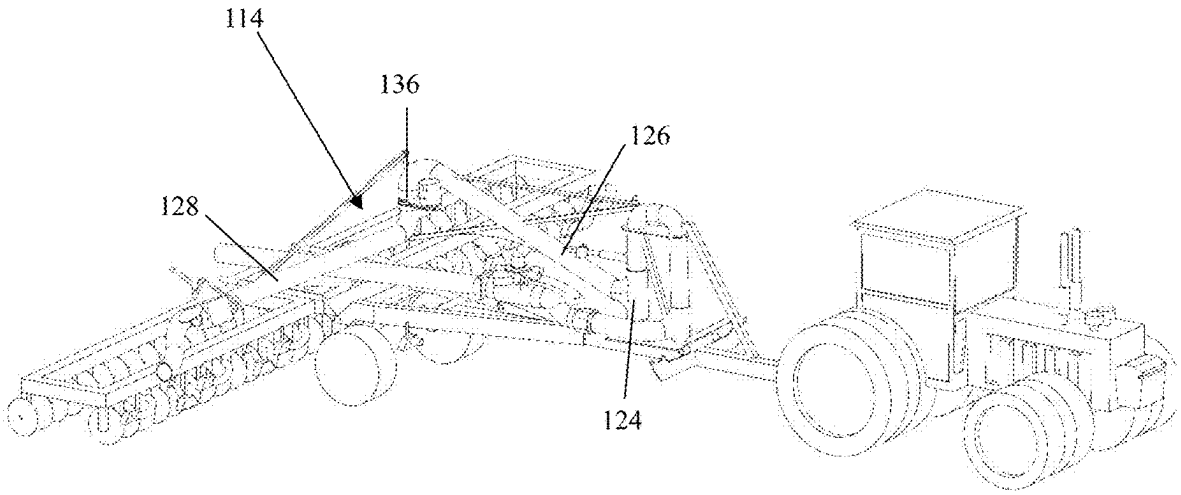


FIG. 15

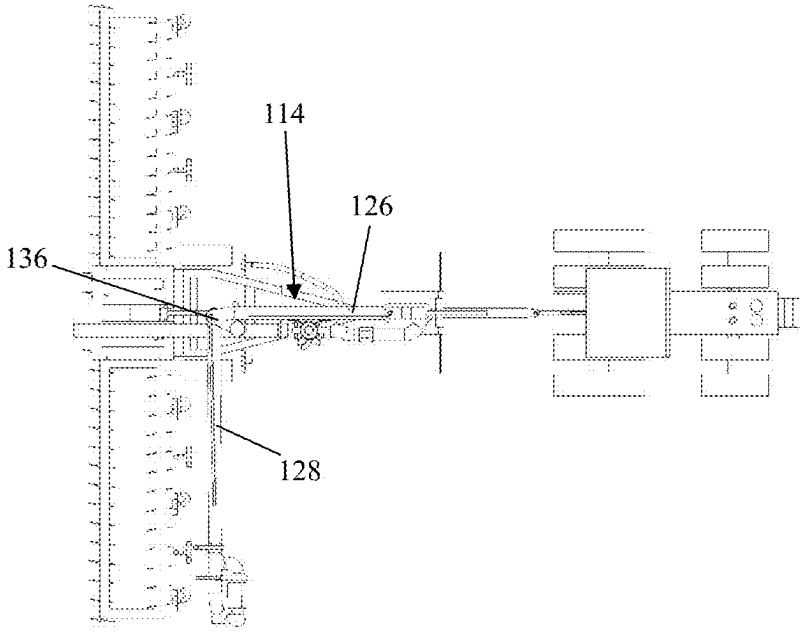


FIG. 16

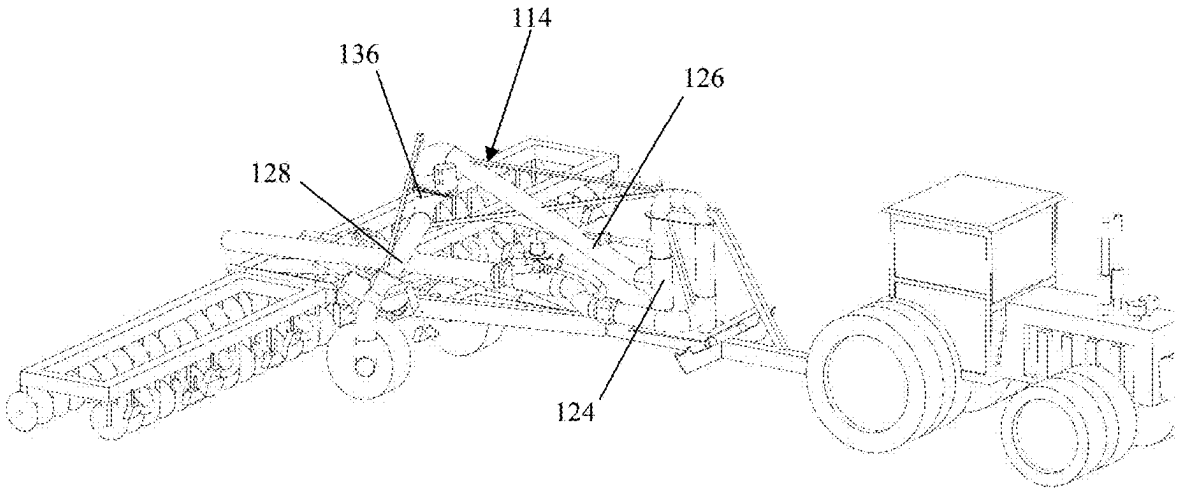


FIG. 17

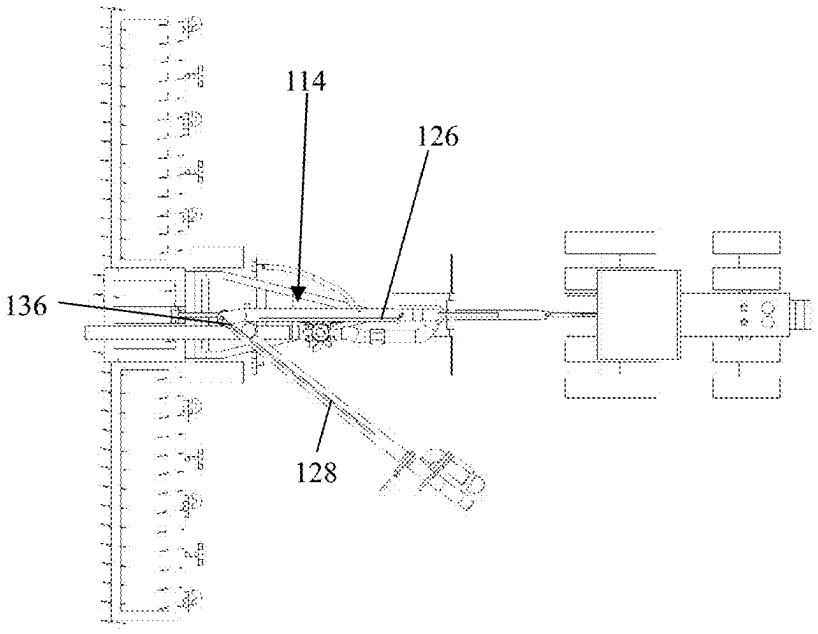


FIG. 18

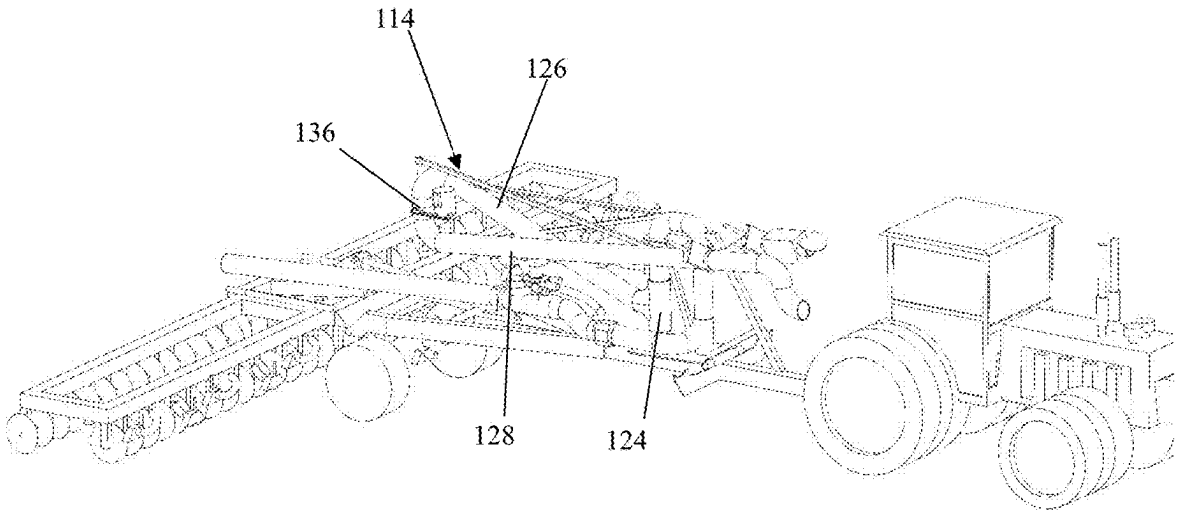


FIG. 19

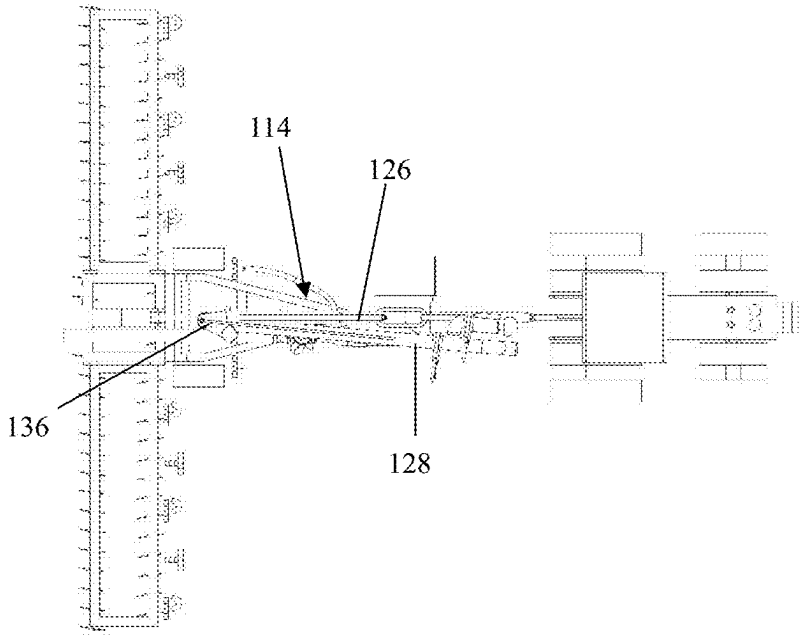


FIG. 20

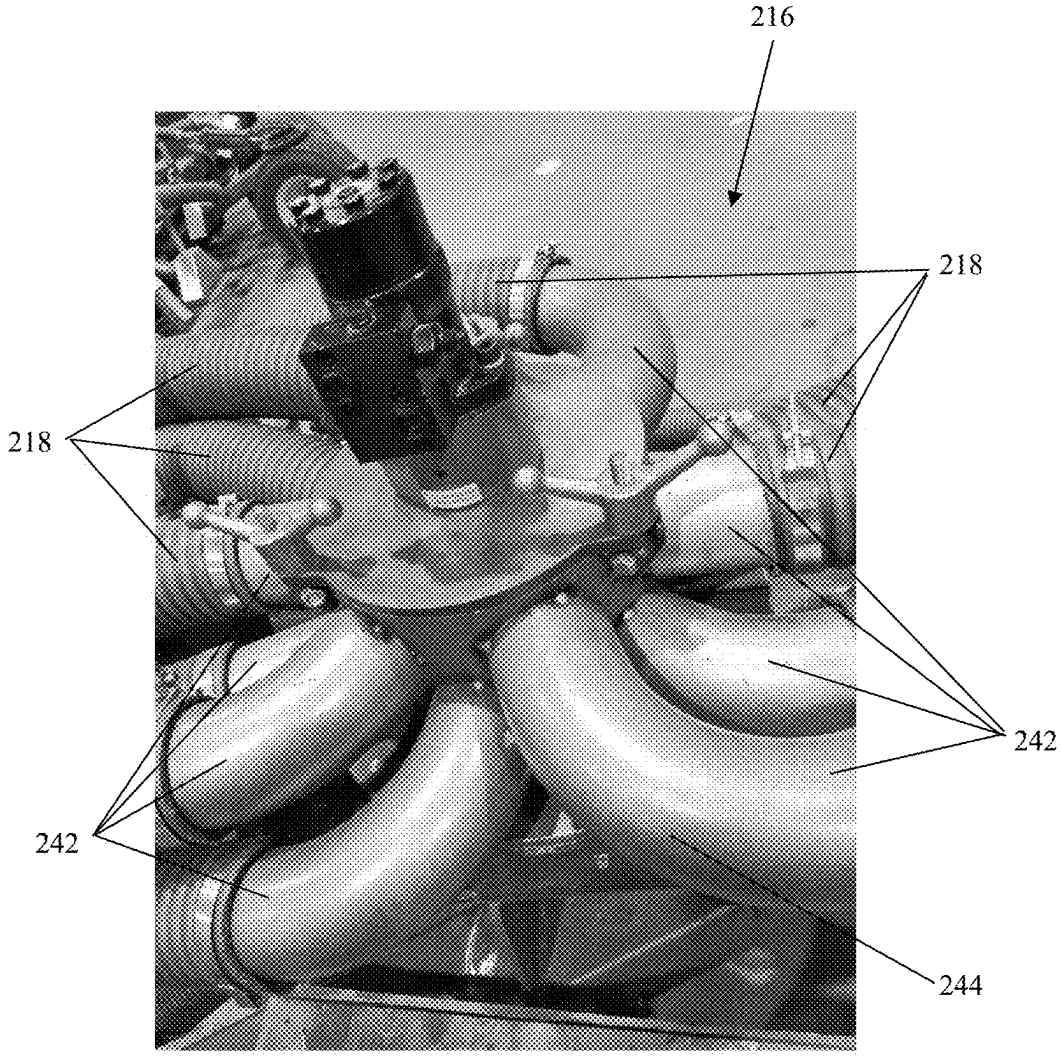
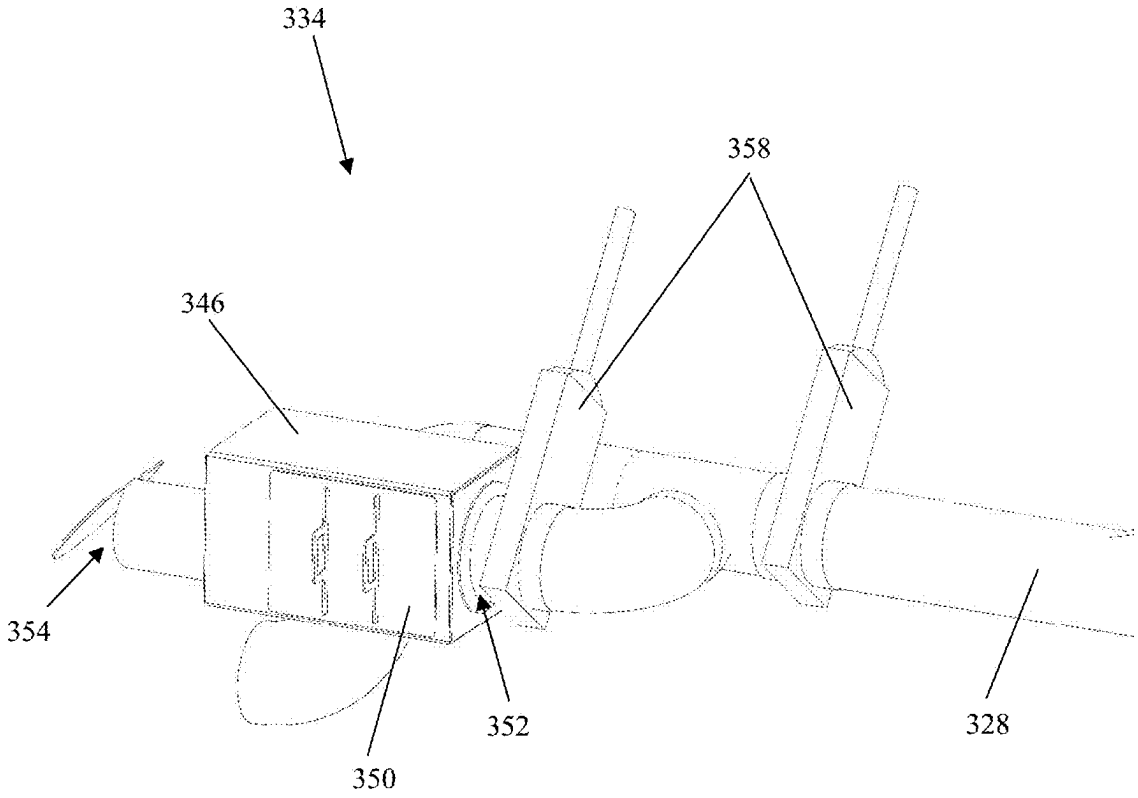


FIG. 21



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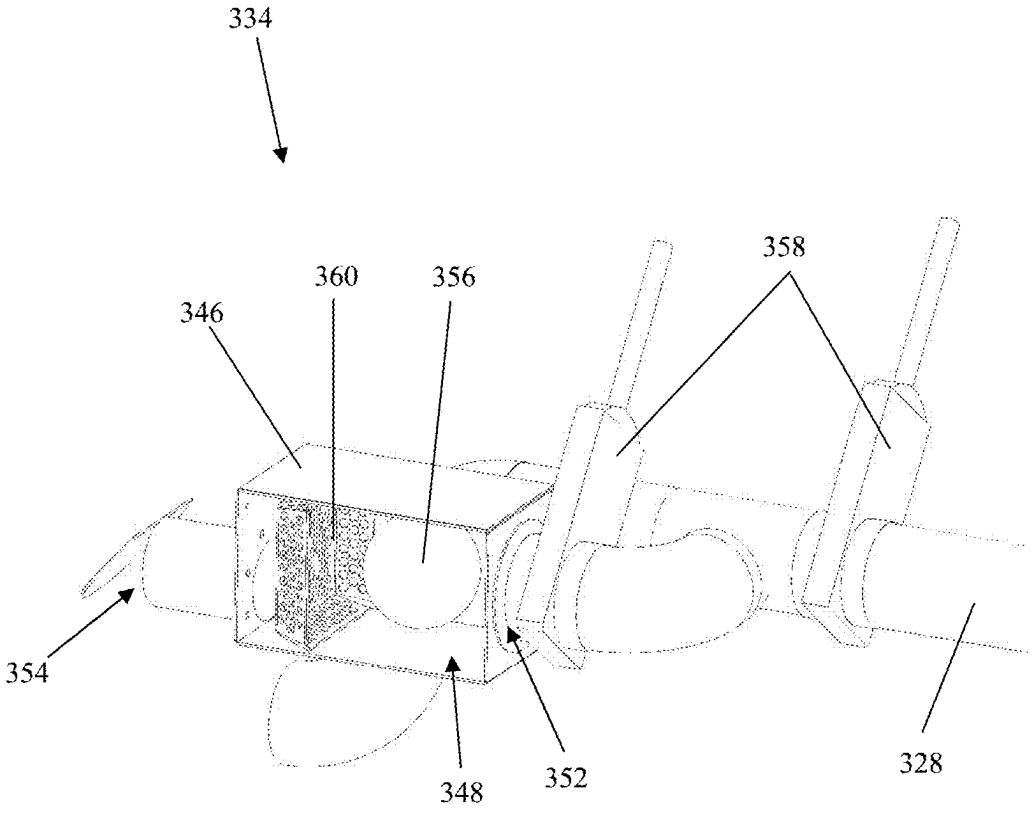

FIG. 23

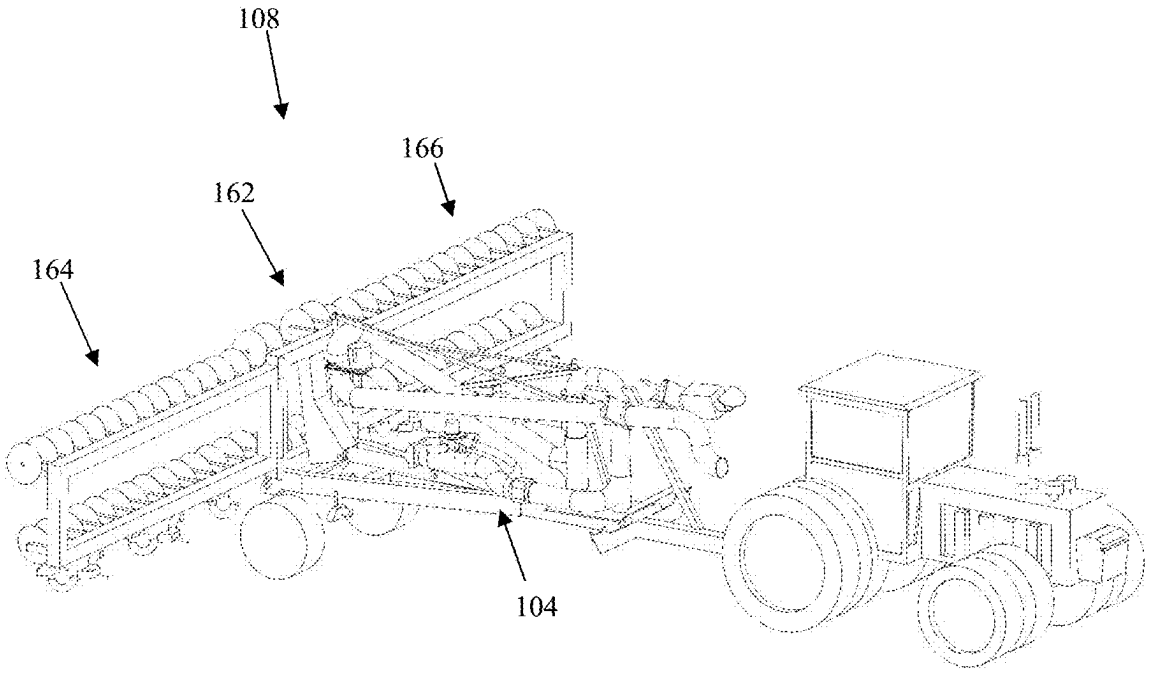

FIG. 24

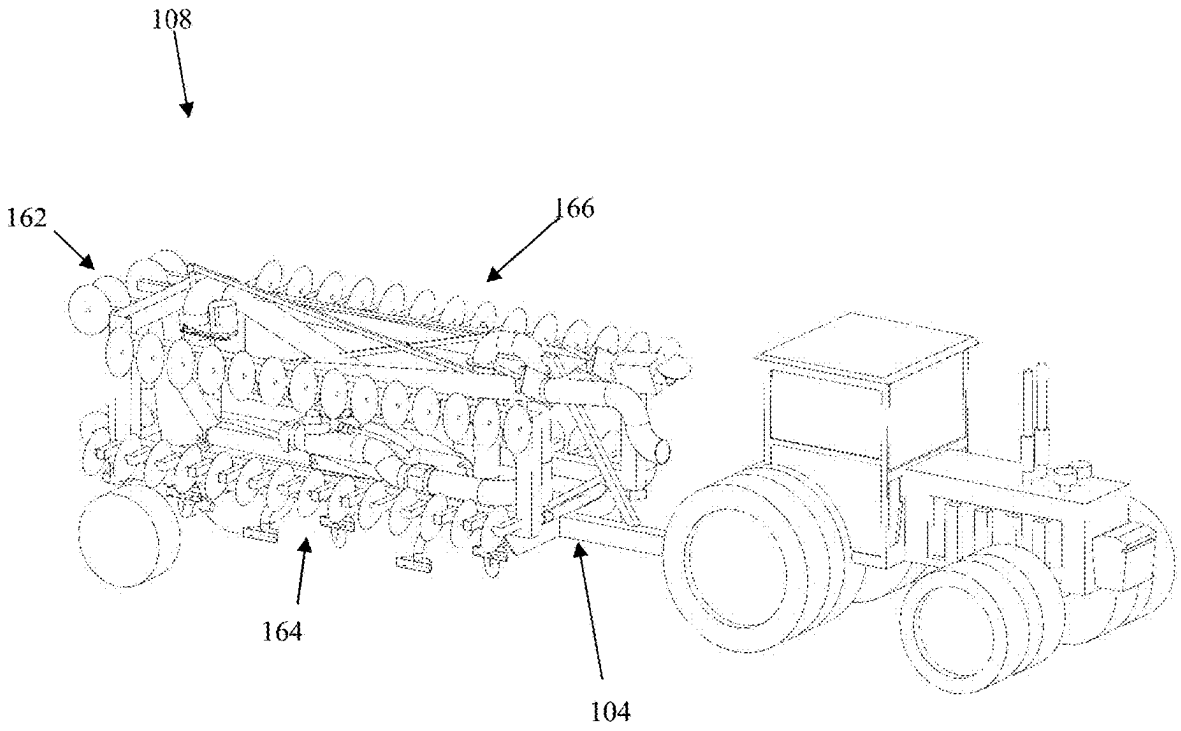

FIG. 25

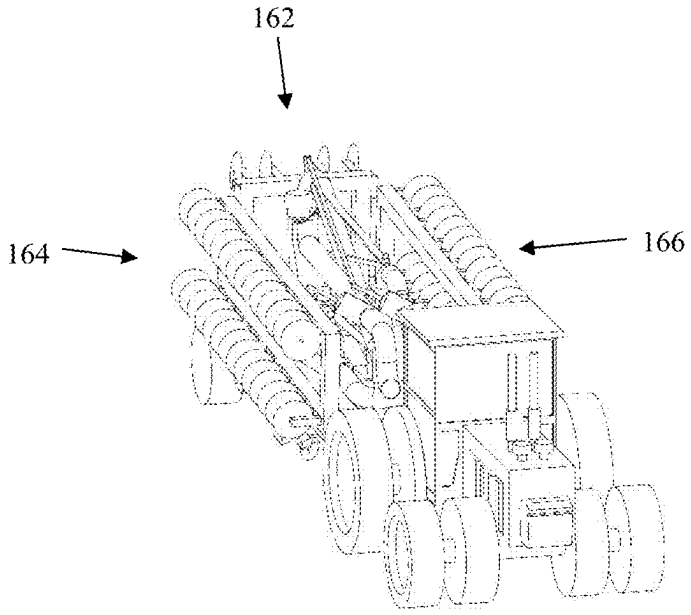

FIG. 26

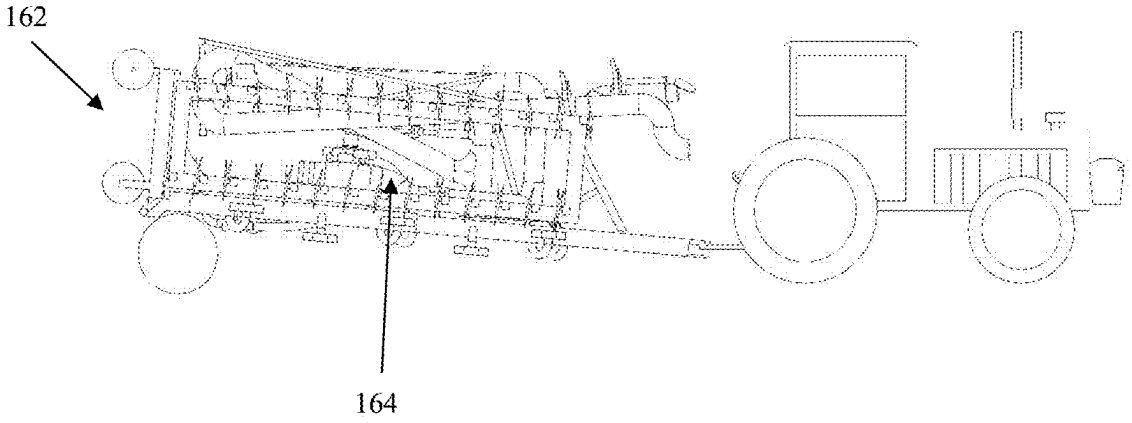

FIG. 27

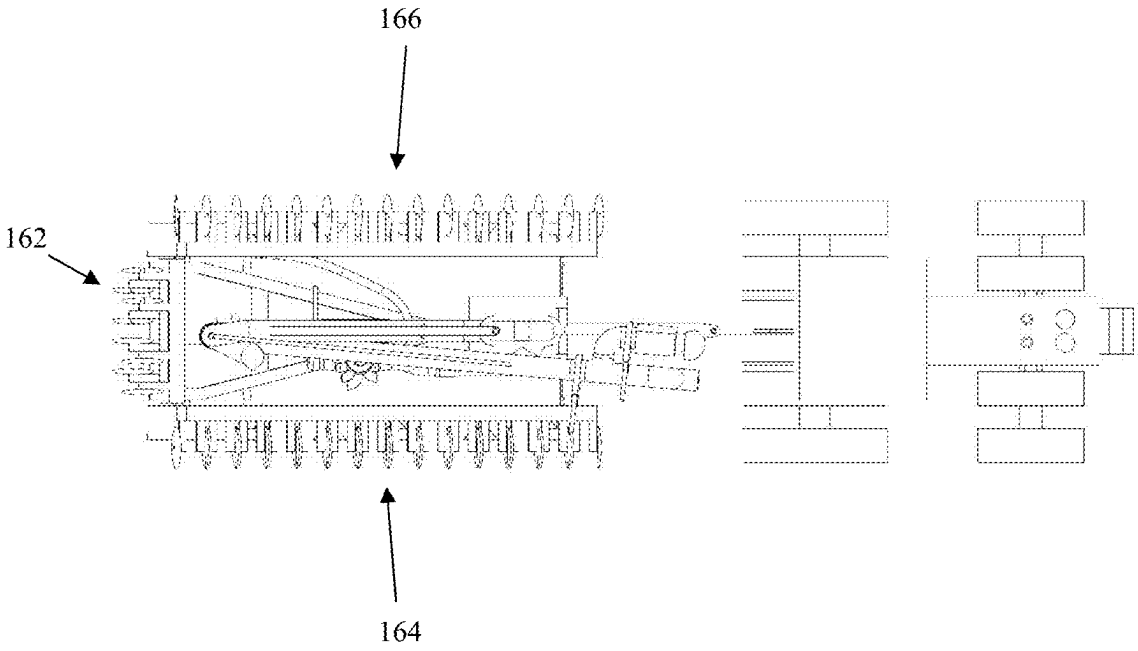

FIG. 28

COMPACT MANURE INCORPORATION SYSTEM

REFERENCE TO RELATED APPLICATIONS

[0001] This patent application claims the benefit of U.S. Provisional Patent Application Ser. No. 63/555,962 filed on Feb. 21, 2024, and entitled COMPACT MANURE INCORPORATION SYSTEM, the disclosure of which is hereby incorporated by reference herein in its entirety.

TECHNICAL FIELD

[0002] The present application relates to manure incorporation systems and methods for using the same. More specifically, the present application relates to a compact manure incorporation system.

BACKGROUND

[0003] Ground engagement systems refer to agricultural equipment that can be used for a variety of applications, including tilling soil. These ground engagement systems can also be used to facilitate the application of manure and other liquid nutrients as part of a manure incorporation system. Because of their sizes and constructions, such ground engagement systems are difficult to transport. Such issues can be more pronounced for manure incorporation systems that include additional equipment for distributing manure, such as swing pipes, distributors, and hoses, among other components. Conventional ground engagement systems, and particularly, manure incorporation systems may have portions that can be raised and/or rotated to form a more compact unit for transport, but such capabilities are typically limited by the size and nature of the equipment itself, particularly for configurations including swing pipes, distributors, and hoses, which are typically bulky and centrally positioned components. What is desired is a manure incorporation system that allows for improved mobility and ergonomic use of the same.

SUMMARY

[0004] In accordance with one embodiment, a compact manure incorporation system includes a frame defining a longitudinal axis; a manure distribution system comprising a swing pipe, the swing pipe comprising a first, proximal section and a second, distal section; wherein a proximal end of the proximal section is mounted to the frame and a distal end of the proximal section is pivotably connected to a proximal end of the distal section; and wherein the proximal section and distal section are configured to pivot relative to each other between an extended swing pipe position and a compact swing pipe position.

[0005] In accordance with another embodiment, a distributor for a compact manure incorporation system includes an inlet configured for connection with a supply source; and a plurality of hose outlets, wherein each of the plurality of hose outlets is configured for connection with a plurality of distribution hoses; wherein the plurality of hose outlets, at respective connections with the plurality of distribution hoses, are in a similar axial configuration, such that the plurality of hose outlets are parallel or substantially parallel to each other.

[0006] In accordance with another embodiment, a cleanout ball catcher for a compact manure incorporation system includes a catcher body defining an interior, an inlet, and an outlet and having a removable cover; and a screen residing within the interior to obstruct a cleanout ball entering through the inlet from exiting through the outlet.

BRIEF DESCRIPTION OF DRAWINGS

[0007] The present disclosure will be more readily understood from a detailed description of some example embodiments taken in conjunction with the following figures:

[0008] FIG. **1** depicts a perspective view of a manure incorporation system being pulled by a tractor where a swing pipe is positioned in a straight line, according to one embodiment;

[0009] FIG. **2** depicts a top view of the manure incorporation system configuration of FIG. **1**;

[0010] FIG. **3** depicts a side view of the manure incorporation system configuration of FIG. **1**;

[0011] FIG. **4** depicts a perspective view of the manure incorporation system of FIG. **1**, where a swing pipe is positioned at a 30° angle relative to a longitudinal axis of a frame;

[0012] FIG. **5** depicts a top view of the manure incorporation system configuration of FIG. **4**;

[0013] FIG. **6** depicts a perspective view of the manure incorporation system of FIG. **1**, where the swing pipe is positioned at a 45° angle relative to the longitudinal axis of the frame;

[0014] FIG. **7** depicts a top view of the manure incorporation system configuration of FIG. **6**;

[0015] FIG. **8** depicts a side view of the manure incorporation system configuration of FIG. **6**;

[0016] FIG. **9** depicts a perspective view of the manure incorporation system of FIG. **1**, where the swing pipe is positioned at a 90° angle relative to the longitudinal axis of the frame;

[0017] FIG. **10** depicts a top view of the manure incorporation system configuration of FIG. **9**;

[0018] FIG. **11** depicts a perspective view of the manure incorporation system of FIG. **1**, where the swing pipe is positioned at a 120° angle relative to the longitudinal axis of the frame;

[0019] FIG. **12** depicts a top view of the manure incorporation system configuration of FIG. **11**;

[0020] FIG. **13** depicts a perspective view of the manure incorporation system of FIG. **1**, where a distal portion of the swing pipe is positioned at a 45° angle relative to a proximal portion of the swing pipe and the longitudinal axis of the frame;

[0021] FIG. **14** depicts a top view of the manure incorporation system configuration of FIG. **13**;

[0022] FIG. **15** depicts a perspective view of the manure incorporation system of FIG. **1**, where the distal portion of the swing pipe is positioned at a 90° angle relative to the proximal portion of the swing pipe and the longitudinal axis of the frame;

[0023] FIG. **16** depicts a top view of the manure incorporation system configuration of FIG. **15**;

[0024] FIG. **17** depicts a perspective view of the manure incorporation system of FIG. **1**, where the distal portion of the swing pipe is positioned at a 120° angle relative to the proximal portion of the swing pipe and the longitudinal axis of the frame;

[0025] FIG. **18** depicts a top view of the manure incorporation system configuration of FIG. **17**;

[0026] FIG. **19** depicts a perspective view of the manure incorporation system of FIG. **1**, where the distal portion of the swing pipe is positioned at a nearly 180° angle relative to the proximal portion of the swing pipe and the longitudinal axis of the frame;

[0027] FIG. **20** depicts a top view of the manure incorporation system configuration of FIG. **19**;

[0028] FIG. **21** depicts a photographic image of a distributor according to one embodiment;

[0029] FIG. **22** depicts a perspective view of a cleanout ball catcher according to one embodiment;

[0030] FIG. **23** depicts a perspective, cutaway view of the cleanout ball catcher of FIG. **22**;

[0031] FIG. **24** depicts a perspective view of the manure incorporation system configuration of FIG. **19**, but with a toolbar rotated to a first vertical position, 90° relative to a horizontal position;

[0032] FIG. **25** depicts a perspective view of the manure incorporation system configuration of FIG. **24**, but with outer portions of the toolbar rotated forward to a compact position;

[0033] FIG. **26** depicts another perspective view of the manure incorporation system configuration of FIG. **24**;

[0034] FIG. **27** depicts a side view of the manure incorporation system configuration of FIG. **24**; and

[0035] FIG. **28** depicts a top view of the manure incorporation system configuration of FIG. **24**.

DETAILED DESCRIPTION

[0036] For the purpose of the present description and of the appended claims, except where otherwise indicated, all numbers expressing amounts, quantities, percentages, and so forth, are to be understood as being modified in all instances by the term "about." Also, all ranges include any combination of the maximum and minimum points disclosed and include any intermediate ranges therein, which may or may not be specifically enumerated herein.

[0037] The present disclosure, in at least one of the mentioned aspects, can be implemented according to one or more of the present embodiments, optionally combined together.

[0038] For the purpose of the present description and of the appended claims, the words "a" or "an" should be read to include one or at least one and the singular also includes the plural unless it is obvious that it is meant otherwise. This is done merely for convenience and to give a general sense of the disclosure.

[0039] As will be described herein, improved manure incorporation systems are disclosed. Referring to FIG. **1**, for example, a manure incorporation system **100** is shown being pulled by a tractor **102**. The manure incorporation system **100** can include a frame **104** having wheels **106**. It will be appreciated, however, that a manure incorporation system can be pulled by any of a variety of vehicles or be self-powered and a frame can include tracks in addition to or instead of wheels. The frame **104** can be connected to a toolbar **108** and support a manure distribution system **110**. The toolbar **108** can be a ground engaging system or a portion thereof. In one embodiment, the toolbar **108** can include a plurality of discs **112**, organized in multiple rows and sections. It will be appreciated that, in other embodiments, a toolbar can include a plurality of sweeps, coulters, points, and any of a variety of other suitable components in addition to or instead of discs. Among other components, the manure distribution system **110** can include a swing pipe **114**, a distributor **116**, a plurality of distribution hoses **118**, a plurality of injectors **120**, and a plurality of manure splash hoods **122** (or splash pans).

[0040] The swing pipe **114** can be mounted to the frame **104** by a base swivel joint **124** and configured for connection with a supply source (e.g., hose) (not shown) to receive manure and/or other liquid nutrients. The swing pipe **114** can include a first, proximal section **126** and a second, distal section **128**. As shown, for example, in FIG. **1**, a proximal end of the proximal section **126** can be joined to the base swivel joint **124** and a distal end of the distal section **128** can include a supply hose connector **130**, which can include a connector swivel joint **132**. The distal end of the distal section **128** can further include a cleanout ball catcher **134**, which is described in greater detail herein. The base swivel joint **124** can be generally vertically oriented and rotatable about a base swivel joint axis B, which can be generally perpendicular to the longitudinal axis L of the frame **104** and/or a ground. Accordingly, in use, the swing pipe **114** can pivot about the base swivel joint axis B to facilitate receipt of manure and/or other liquid nutrients. Referring to FIGS. **1-12**, the swing pipe **114**, in an extended position, can be pivoted over a wide range of angles. For example, as shown in FIGS. **1-3**, the swing pipe **114** can extend rearwardly from the base swivel joint **124** and be positioned in a straight line, parallel or substantially parallel to the longitudinal axis L of the frame **104**. As shown in FIGS. **4** and **5**, the swing pipe **114** can be positioned in a straight line, at a 30° angle relative to the longitudinal axis L of the frame **104**. As shown in FIGS. **6-8**, the swing pipe **114** can be positioned in a straight line, at a 45° angle relative to the longitudinal axis L of the frame **104**. As shown in FIGS. **9** and **10**, the swing pipe **114** can be positioned in a straight line, at a 90° angle relative to the longitudinal axis L of the frame **104**. As shown in FIGS. **11** and **12**, the swing pipe **114** can be positioned in a straight line, at a 120° angle relative to the longitudinal axis L of the frame **104**. It will be appreciated, however, that a swing pipe can be rotated to any of a range of angles in either direction relative to a longitudinal axis of a frame.

[0041] Referring back to FIG. **1**, the swing pipe **114** can further include an interior swivel joint **136** to connect the proximal section **126** with the distal section **128**. The interior swivel joint **136** can allow the distal section **128** to pivot relative to the proximal section **126**. In addition to the rotatability provided by the base swivel joint **124**, and, referring to FIGS. **13-20**, the interior swivel joint **136** can provide further mobility and adaptability for the swing pipe **114** and the manure distribution system **110**. For example, as shown in FIGS. **13** and **14**, the proximal section **126** of the swing pipe **114** can be positioned in a straight line, parallel or substantially parallel to the longitudinal axis L of the frame **104**, while the distal section **128** of the swing pipe **114** can be positioned at a 45° angle relative to the proximal section **126** and the longitudinal axis L of the frame **104**. As shown in FIGS. **15** and **16**, the proximal section **126** of the swing pipe **114** is positioned in a straight line, parallel or substantially parallel to the longitudinal axis L, while the distal section **128** of the swing pipe **114** can be positioned at a 90° angle relative to the proximal section **126**. Likewise, as shown in FIGS. **17** and **18**, the proximal section **126** of the swing pipe **114** is positioned in a straight line, parallel or substantially parallel to the longitudinal axis L, while the

distal section **128** of the swing pipe **114** can be positioned at a 120° angle relative to the proximal section **126**. And as shown in FIGS. **19** and **20**, the proximal section **126** of the swing pipe **114** can be positioned in a straight line, parallel or substantially parallel to the longitudinal axis L, while the distal section **128** of the swing pipe **114** can be positioned at or nearly a 180° angle relative to the proximal section **126**, such that the swing pipe **114** can be, essentially, folded back on itself in a compact position. Other configurations of the proximal section **126** and distal section **128** over-and-above the illustrative configurations set forth above are contemplated and included herein.

[0042] In certain embodiments, and as shown, for example, in FIG. **13**, the interior swivel joint **136** can be rotatable about an interior swivel joint axis I. In certain embodiments, the interior swivel joint axis I can be oriented substantially vertically, but angled slightly rearwardly, such that the distal section **128** ascends slightly, relative to a horizontal plane defined by the frame **104** and/or the ground, as the distal section is rotated toward the proximal section **126**. Such configuration can allow for greater rotatability of the distal section **128** relative to the proximal section **126** and a more compact configuration for storage and transport. In some embodiments, the distal section **128** and the proximal section **126** can be of a same or similar length, such that the swing pipe **114**, in the compact position, can be reduced to about half of its length. It will be appreciated, however, that an interior swivel joint axis can be oriented in a variety of suitable configurations. As shown, for example, in FIG. **1**, rotation of the distal section **128** about the interior swivel joint **136** can be effected or facilitated by a hydraulic motor **138** (i.e., rotational actuator). It will be appreciated, however, that any of a variety of suitable actuators may be used to effect or facilitate rotation of a swing pipe or portion thereof. In certain embodiments, one or more sections of a swing pipe can be extendable and/or telescoping.

[0043] As shown, for example, in FIG. **1**, the base swivel joint **124** can connect the swing pipe **114** to fluid pipe **140**. The fluid pipe can also be in fluid connection with the distributor **116**, such that the fluid pipe **140** can allow for a flow of manure and/or other liquid nutrients to the distributor **116**. In certain embodiments, and as shown in FIG. **1**, the fluid pipe **140** can be a non-rotating pipe, fixed to the frame **104**. It will be appreciated, however, that a fluid pipe can be provided in a variety of suitable configurations. In certain embodiments, the distributor **116** can be mounted to the frame.

[0044] In certain embodiments, and as shown, for example, in FIG. **21**, the distributor **216**, or manifold, can include an inlet configured for connection with the fluid pipe **140** and a plurality of hose outlets **242** configured for connection with a plurality of distribution hoses **218**. In certain embodiments, each of the plurality of hose outlets **242** can be adjoined to and in fluid communication with one of the plurality of distribution hoses **218**. The manure incorporation system **100** of FIG. **1** also shows the distributor **116** having hose outlets **142** and the distribution hose **118**, but only one distribution hose is depicted in FIG. **1** for the sake of clarity. It is understood that distributor **118** can be the same as or similar to distributor **216**. As shown, for example, in FIGS. **1** and **21**, each of the plurality of hose outlets **142**, **242** can be aligned such that fluid flows through the plurality of hose outlets **142**, **242** at respective connections with the plurality of distribution hoses **118**, **218** can be in the same or similar axial configuration. For example, each of the respective fluid flows at the respective connections between the plurality of hose outlets **142**, **242** and the plurality of distribution hoses **118**, **218** can be parallel or substantially parallel to the longitudinal axis L of the frame **104**, though respective fluids flows may be in opposing directions (i.e., toward a rear or a front of the frame **104**). Accordingly, in certain embodiments, one or more of the plurality of hose outlets **142**, **242** can include an elbow **244** to provide for a desired alignment. Conventional distributors include inflexible, radiating-configured hose outlets that require a relatively large amount of space that must be accounted for in storage and transportation thereof. The present distributor **116**, **216**, however, can allow for a minimal distributor width and a more compact configuration for storage and transport.

[0045] The distribution hoses **118**, **218** can connect to and be in fluid communication with the plurality of injectors **120**, such that the distribution hoses **118**, **218** can allow for a flow of manure and/or other liquid nutrients to the plurality of injectors **120**. Accordingly, in operation, manure and/or other liquid nutrients can flow from the supply hose, through the swing pipe **114**, through the fluid pipe **140**, through the distributor **116**, through the plurality of distribution hoses **118**, **218** to the plurality of injectors **120**, and then onto and/or into the ground.

[0046] In certain embodiments, the toolbar **108**, or portions thereof, can be mounted to the frame **104** with moveable joints, e.g., hydraulic connections, such that the toolbar **108** can be urged downwardly, toward the ground, such that the downward pressure can cause one or more of the plurality of injectors **120** to penetrate the ground. In such embodiments, each of the plurality of injectors **120** can be aligned with a ground-disrupting blade, which can facilitate injection of manure and/or liquid nutrients into a trench. For example, the plurality of discs **112**, which can be positioned at a slight angle relative to the ground, can be pressed into the ground a distance to form trench into which fluid can be injected. In certain embodiments, a second plurality of discs can be provided and angled to push dirt back over the trench, thereby covering the trench with deposited manure and/or liquid nutrients.

[0047] Upon completion of deposition of manure and/or liquid nutrients, fluid can be cleared from the lines, and such cleaning may be desirable prior to storage and transport of components of the manure incorporation system **100**. Application of pressure to lines (e.g., with compressed air) to force an object therethrough, thereby clearing the line, is known in the art. Such conventional methods, however, have drawbacks. For example, the object can be launched great distances and in an unpredictable manner, such that the object can be lost or, potentially, a hazard. In other conventional methods, a large catcher may be provided, but known catchers comprise cages that have limited effectiveness in actually catching the object while spreading fluid to be cleared from the line. Further, such conventional catchers typically require a relatively large amount of space that must be accounted for in storage and transportation thereof.

[0048] As shown in FIGS. **22** and **23**, the distal end of the distal section **328** can further include a cleanout ball catcher **334** including a catcher body **346** defining an interior **348** and having a removable cover **350**. The cleanout ball catcher **334** can further include an inlet **352** and an outlet **354**. In use, a cleanout ball **356** can be forced through the manure

distribution system (e.g., **110**) and valves **358** can be adjusted to route the cleanout ball, and thus, fluid to be cleared in a direction of the cleanout ball catcher **334**. Upon reaching the cleanout ball catcher **334**, the cleanout ball **356** can be caught in the interior **348** of the cleanout ball catcher **334**. In certain embodiments, a screen (e.g., tray **360**) can be positioned within the interior **348** of the cleanout ball catcher **334** to obstruct the cleanout ball **356** but allow for the fluid to be cleared to exit the cleanout ball catcher **334** through the outlet **354**. As shown in FIG. **23**, tray **360** can be placed over the outlet **354**. The present cleanout ball catcher **134**, **334** can effectively retain the cleanout ball **356** while providing sufficient spread upon clearing fluid from the line.

[0049] The present cleanout ball catcher **134**, **334** can also allow for minimal sizing and a more compact configuration for storage and transport. In certain embodiments, the cleanout ball catcher **134**, **334** can be sized to accommodate a size of a line to be cleared and/or air pressure to be applied to the line to be cleared. For example, in certain embodiments, the catcher body **346** can be in the shape of a square, about 12 inches per side; and in other embodiments, sides of the catcher body **346** can be about 16 inches. It will be appreciated, however, that a catcher body can be any of a variety of suitable shapes and configurations over a range of sizes. Similarly, the cleanout ball **356** can be sized to accommodate the line to be cleared, but in certain embodiments, a diameter of the cleanout ball **356** can be about the same size or slightly larger than a diameter of the line to be cleared.

[0050] In certain embodiments, the toolbar **108**, in a ready-for use position, can be mounted such that a plane defined by the toolbar **108** is generally parallel to the ground and can extend laterally on each side from the longitudinal axis L of the frame **104**. In certain embodiments, the incorporation toolbar **108** can include two or more moveable sections, each section being articulatable about one or more toolbar joints. The number and placement of toolbar joints can permit the toolbar sections to be folded, rotated, or otherwise manipulated to minimize the outward extension of the toolbar during transport of the manure incorporation system **100**.

[0051] Referring to FIGS. **24-28**, for example, the toolbar **108** can include a center portion **162** connected on each side to an outer portion **164** and **166**. As shown in FIGS. **24-28**, each of the outer portions **164** and **166** can have a width greater than a width of the center portion **162**. The center portion **162** can be disposed behind the frame **104** and centered with respect to the longitudinal axis L thereof. Each of the outer portions **164**, **166** and center portion **162** can define a plane. In certain embodiments, a total width of the toolbar **108** can span from about 20 feet to about 60 feet, but it will be appreciated that any of a variety of suitable dimensions and configurations can be provided for sections of a toolbar.

[0052] The toolbar **108** can be moveable between the ready-for-use position, as shown in FIGS. **1-20**, and a second, compact position, as shown in FIGS. **25-28**. To convert the toolbar **108** from the ready-for-use position to the compact position, a rear portion of the toolbar **108** is rotated upwardly until the plane defined by the toolbar **108** is oriented vertically or substantially vertically in an intermediate, raised position, as shown in FIG. **24**. In such embodiments, the center portion **162** can be a rearmost portion of the manure incorporation system **100**, such that no portion of the manure incorporation system **100** extends rearwardly of the center portion **162**. Once the toolbar **108** is in the raised position, outer portions **164** and **166** can rotate forwardly about the toolbar joints connecting the outer portions **164** and **166** to the center portion **162** until the planes defined by the outer portions **164** and **166** are parallel or substantially parallel to the longitudinal axis L of the frame **104** in the compact position, as shown in FIGS. **25-28**. As shown in FIG. **25**, for example, when the outer portions **164** and **166** are in the compact position, respective planes of the outer portions can be oriented vertically or substantially vertically and can be parallel or substantially parallel to the longitudinal axis of the frame, and when the swing pipe is also in the compact position, the swing pipe can be positioned between the outer portions. It will be further appreciated that a center portion can also be oriented substantially vertically and either perpendicular or substantially perpendicular to the longitudinal axis of the frame when in the compact position.

[0053] FIGS. **25-28** illustrate a compact nature of the manure incorporation system **100** when the swing pipe **114** and toolbar **108** are in their respective compact positions. It is believed that the present manure incorporation system **100** can allow for a more compact unit for improved storage and transportation. For example, the manure distribution system **110** can be contained or substantially contained by the toolbar **108**, such that components of the manure distribution system **110** are positioned within a width defined by the distance between top portions of the outer portions **164** and **166** in the compact position. As described herein, the sizing and configurations for each of the swing pipe **114**, distributor **116**, and cleanout ball catcher **134** can allow for relatively minimal widths and a more compact manure incorporation system configuration for storage and transport. For example, in certain embodiments, a width of the manure incorporation system **100** in the compact position can be about 14 feet or less; and in other embodiments, the width of the manure incorporation system **100** in the compact position can be about 12 feet or less. The present manure incorporation systems **100** can reduce or eliminate the need to disassemble the same or portions thereof prior to storage and/or transport. Such configurations can also allow for the use of larger manure incorporation systems for the distribution of manure and/or other liquid nutrients. It will be appreciated that while the embodiment shown in FIGS. **1-20** and **24-28** depicts specific types of components (e.g., a high-speed disc), other suitable types of toolbars, frames, and manure distribution systems can be used in a manure incorporation system.

[0054] In certain embodiments, a method of using a compact manure incorporation system can include providing a compact manure incorporation system as described herein, receiving manure through a distal end of the distal section of the swing pipe, and distributing manure from the swing pipe through a plurality of injectors mounted on the toolbar. In such embodiments, the method can also include cleaning the swing pipe by forcing a cleanout ball therethrough. In such embodiments, the method can include moving the proximal section and the distal section of the swing pipe into a compact swing pipe position; and moving a first outer portion and a second outer portion of the toolbar to a compact toolbar position, such that when the first and second outer portions are in the compact toolbar position, and when

the swing pipe is in the compact swing pipe position, the swing pipe is positioned between the first and second outer portions of the toolbar.

[0055] It will be appreciated that a manure incorporation system can include a high-speed disc (i.e., parallel disc) available from Landoll; an injector can be Bazooka-style injector, available from Bazooka Farmstar; a distributor can be a DosiMat DMX distributor available from Vogelsang US, Ravenna, Ohio; and a distribution hose can be a rubber (e.g., EPDM) hose with a polyethylene helix, available from The Hose Guru, Fort Wayne, Indiana. It will be further appreciated that other components can be obtained from commercial outlets, as desired, and that all connections between components can be of a variety of suitable connections as known in the art.

[0056] In various embodiments disclosed herein, a single component can be replaced by multiple components and multiple components can be replaced by a single component to perform a given function or functions. Except where such substitution would not be operative, such substitution is within the intended scope of the embodiments.

[0057] The foregoing description of embodiments and examples has been presented for purposes of illustration and description. It is not intended to be exhaustive or limiting to the forms described. Numerous modifications are possible in light of the above teachings. Some of those modifications have been discussed, and others will be understood by those skilled in the art. The embodiments were chosen and described in order to best illustrate principles of various embodiments as are suited to particular uses contemplated. The scope is, of course, not limited to the examples set forth herein, but can be employed in any number of applications and equivalent devices by those of ordinary skill in the art. Rather it is hereby intended the scope of the invention to be defined by the claims appended hereto.

What is claimed is:

1. A compact manure incorporation system comprising:
- a frame defining a longitudinal axis;
- a manure distribution system comprising a swing pipe, the swing pipe comprising a first, proximal section and a second, distal section;
- wherein a proximal end of the proximal section is mounted to the frame and a distal end of the proximal section is pivotably connected to a proximal end of the distal section; and
- wherein the proximal section and distal section are configured to pivot relative to each other between an extended swing pipe position and a compact swing pipe position.

2. The compact manure incorporation system of claim **1**, wherein the proximal section and distal section are connected by an interior swivel joint.

3. The compact manure incorporation system of claim **2**, wherein the interior swivel joint is rotatable about an interior swivel joint axis, wherein the interior swivel joint axis is oriented substantially vertically.

4. The compact manure incorporation system of claim **1**, wherein the proximal section is pivotable relative to the frame.

5. The compact manure incorporation system of claim **1**, further comprising a toolbar mounted to the frame.

6. The compact manure incorporation system of claim **5**, wherein the toolbar comprises a first outer portion and a second outer portion, wherein each of the first and second outer portions defines a plane and is configured to move between a ready-for-use toolbar position and a compact toolbar position; and
- wherein, in the compact toolbar position, respective planes of the first and second outer portions are parallel or substantially parallel to the longitudinal axis of the frame.

7. The compact manure incorporation system of claim **6**, wherein, when in the compact toolbar position, the respective planes of the first and second outer portions are oriented vertically or substantially vertically.

8. The compact manure incorporation system of claim **7**, wherein, when the first and second outer portions are in the compact toolbar position, and when the swing pipe is in the compact swing pipe position, the swing pipe is positioned between the first and second outer portions.

9. The compact manure incorporation system of claim **8**, wherein toolbar further comprises a center portion defining a plane and configured to move between the ready-for-use toolbar position and the compact toolbar position.

10. The compact manure incorporation system of claim **9**, wherein, when in the compact toolbar position, the plane of the center portion is oriented substantially vertically and either perpendicular or substantially perpendicular to the longitudinal axis of the frame, such that the first, second, and center portions of the toolbar surround the swing pipe in the compact swing pipe position.

11. The compact manure incorporation system of claim **1**, wherein the toolbar further comprises a ground engaging system including a plurality of discs, sweeps, coulters, or points.

12. The compact manure incorporation system of claim **1**, wherein the manure distribution system further comprises:
- a distributor in fluid connection with the swing pipe and having a plurality of hose outlets;
- a plurality of distribution hoses, wherein each of the plurality of distribution hoses is joined to and in fluid communication with one of the plurality of hose outlets, and
- a plurality of injectors in fluid connection with the plurality of distribution hoses.

13. The compact manure incorporation system of claim **12**, wherein the plurality of hose outlets, at respective connections with the plurality of distribution hoses, are in a similar axial configuration.

14. The compact manure incorporation system of claim **13**, wherein the plurality of hose outlets, at respective connections with the plurality of distribution hoses, are parallel or substantially parallel to the longitudinal axis of the frame.

15. The compact manure incorporation system of claim **1**, wherein a distal end of the distal section is configured for connection with a manure supply source; and
- wherein the distal end of the distal section comprises a cleanout ball catcher.

16. The compact manure incorporation system of claim **15**, wherein the cleanout ball catcher comprises:
- a catcher body defining an interior, an inlet, and an outlet and having a removable cover; and
- a screen configured for positioning within the interior to obstruct a cleanout ball entering through the inlet from exiting through the outlet.

17. A method of using the compact manure incorporation system, the method comprising:

providing the compact manure incorporation system of claim **1**;

receiving manure through a distal end of the distal section of the swing pipe;

distributing manure from the swing pipe through a plurality of injectors mounted on the toolbar;

moving the proximal section and the distal section of the swing pipe into a compact swing pipe position; and

moving a first outer portion and a second outer portion of a toolbar mounted to the frame to a compact toolbar position, such that when the first and second outer portions are in the compact toolbar position, and when the swing pipe is in the compact swing pipe position, the swing pipe is positioned between the first and second outer portions of the toolbar.

18. The method of claim **17**, further comprising:

cleaning the swing pipe by forcing a cleanout ball therethrough.

19. A distributor for a compact manure incorporation system, the distributor comprising:

an inlet configured for connection with a supply source; and

a plurality of hose outlets, wherein each of the plurality of hose outlets is configured for connection with a plurality of distribution hoses;

wherein the plurality of hose outlets, at respective connections with the plurality of distribution hoses, are in a similar axial configuration, such that the plurality of hose outlets are parallel or substantially parallel to each other.

20. A cleanout ball catcher for a compact manure incorporation system, the ball catcher comprising:

a catcher body defining an interior, an inlet, and an outlet and having a removable cover; and

a screen residing within the interior to obstruct a cleanout ball entering through the inlet from exiting through the outlet.

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