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(54) **CROP CART CLEANING AND UNLOADING SYSTEM**

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(63) Continuation of application No. 16/425,518, filed on May 29, 2019, now Pat. No. 10,542,677.

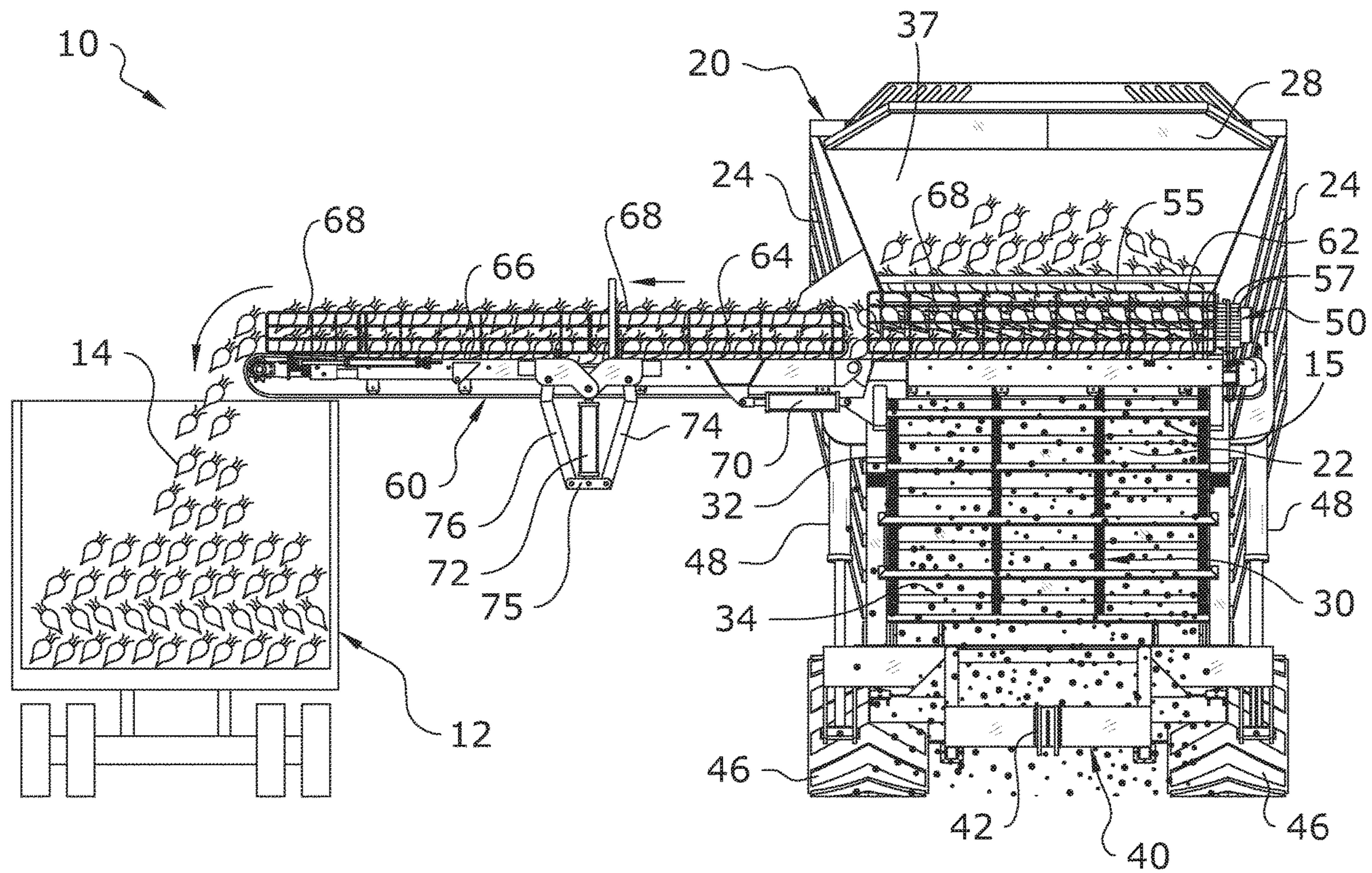
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(57) **ABSTRACT**

A crop cart cleaning and unloading system for cleaning debris such as dirt and rocks from a crop as the crop is being transferred between a hopper of a crop cart and a transport vehicle. The crop cart cleaning and unloading system generally includes a hopper for receiving a crop such as potatoes. The hopper transfers the crop onto a cleaning bed on which the crop is cleaned of debris, with the debris falling underneath the cleaning bed. The crop is conveyed across the cleaning bed as it is cleaned, with the cleaned crop being transferred from the cleaning bed onto an unloading conveyor. The unloading conveyor then transfers the cleaned crop to another location to be discharged, such as directly into a transport vehicle for further transport and processing.



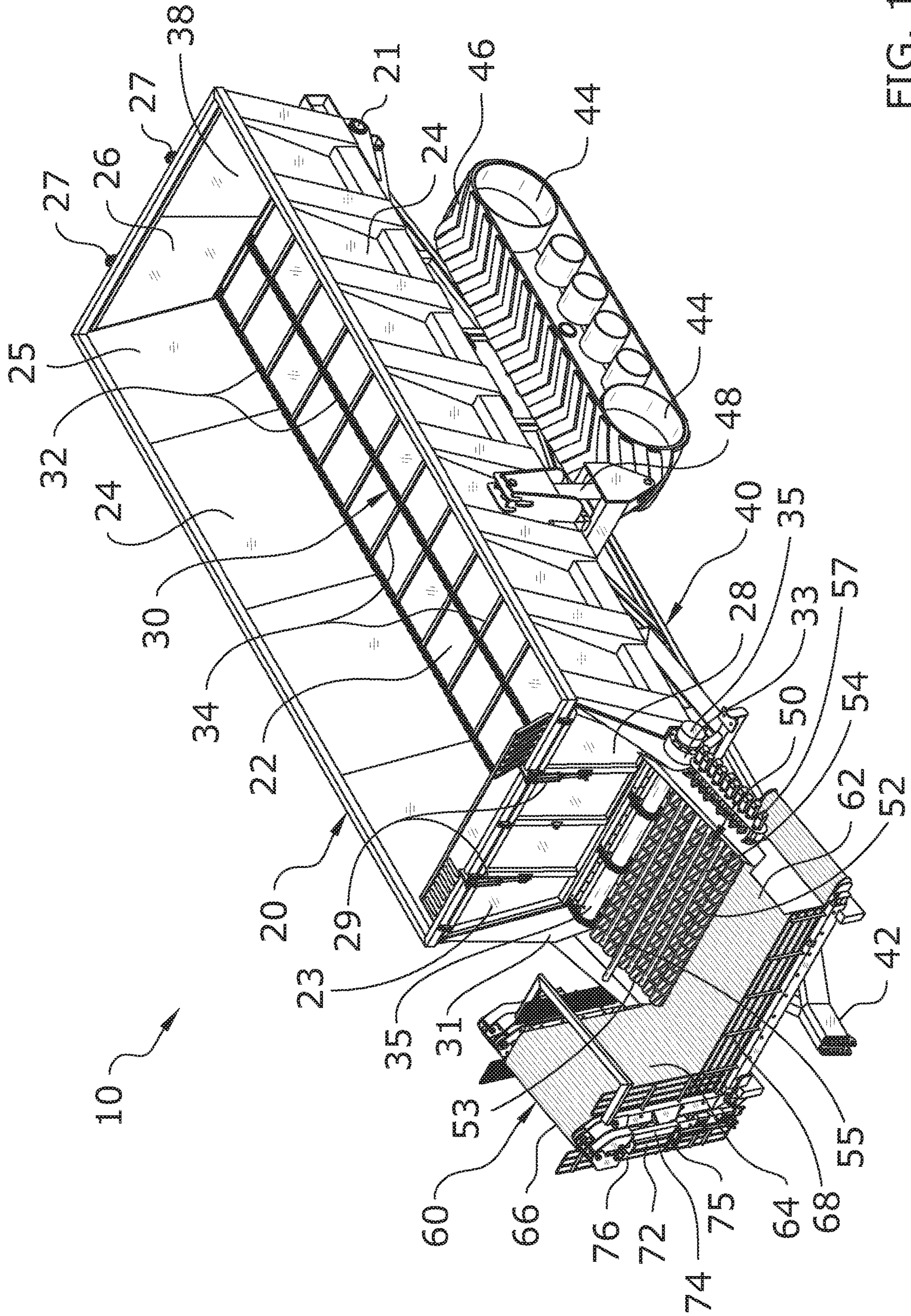


FIG. 1

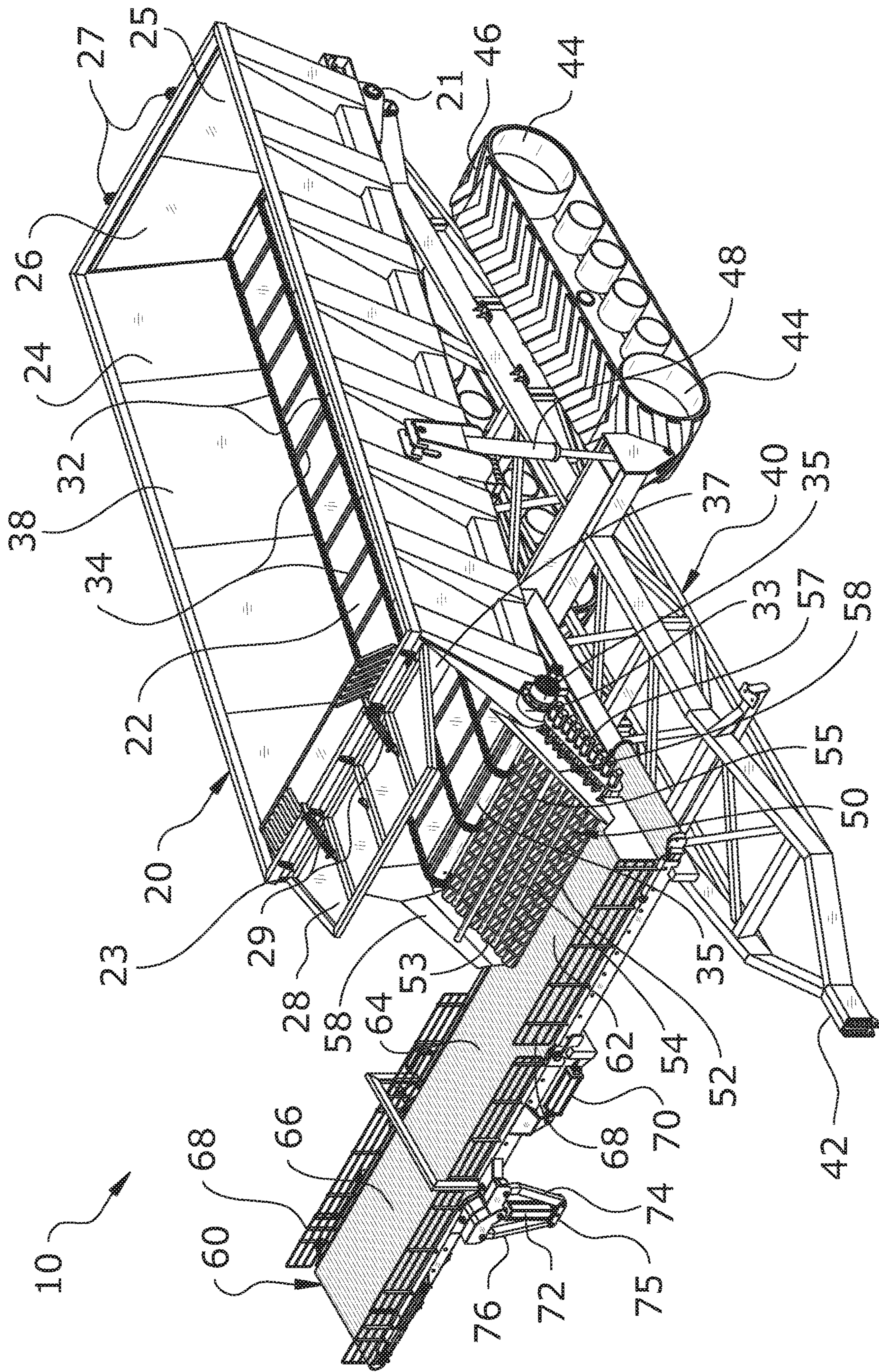


FIG. 2

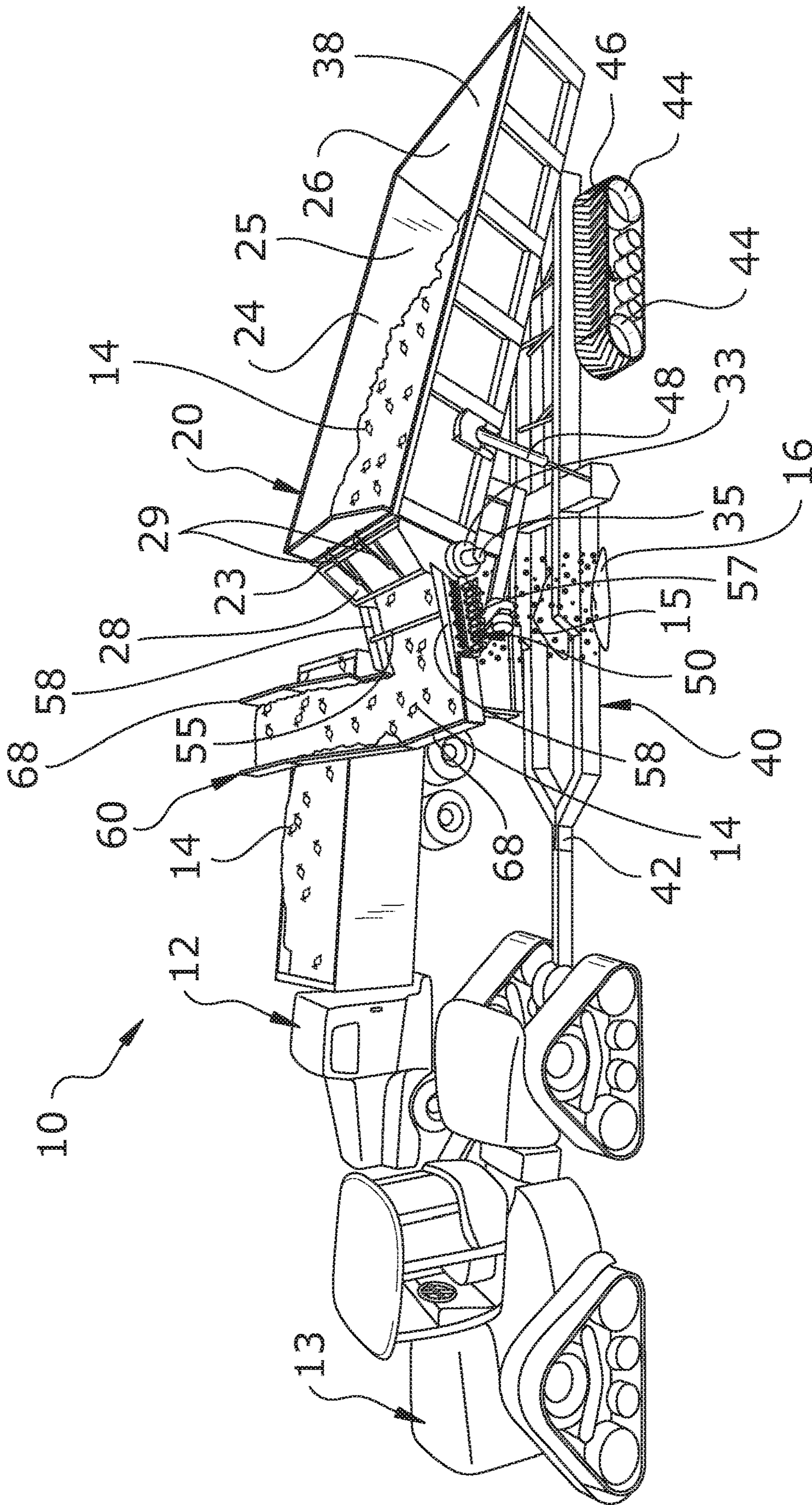


FIG. 3

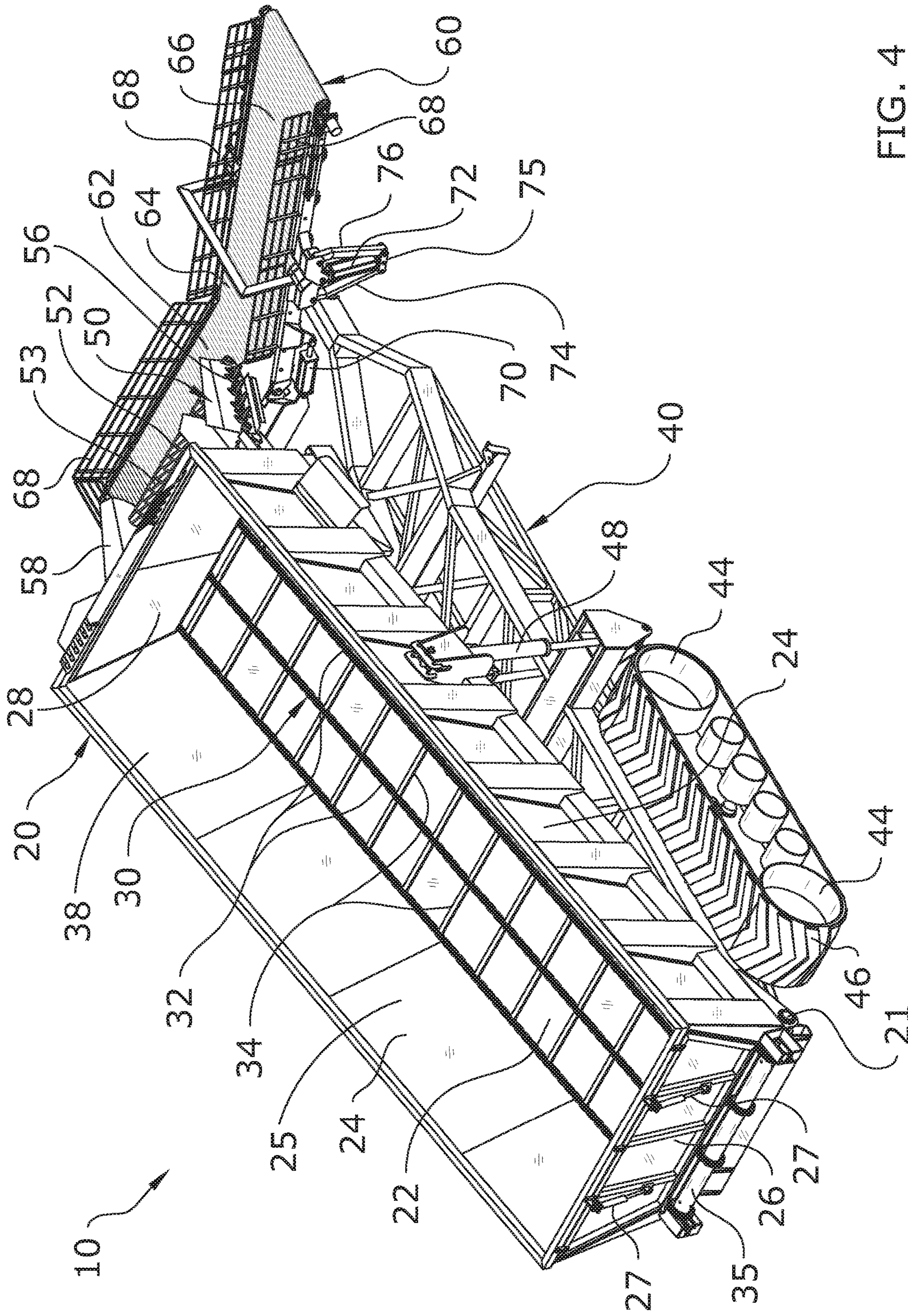


FIG. 4

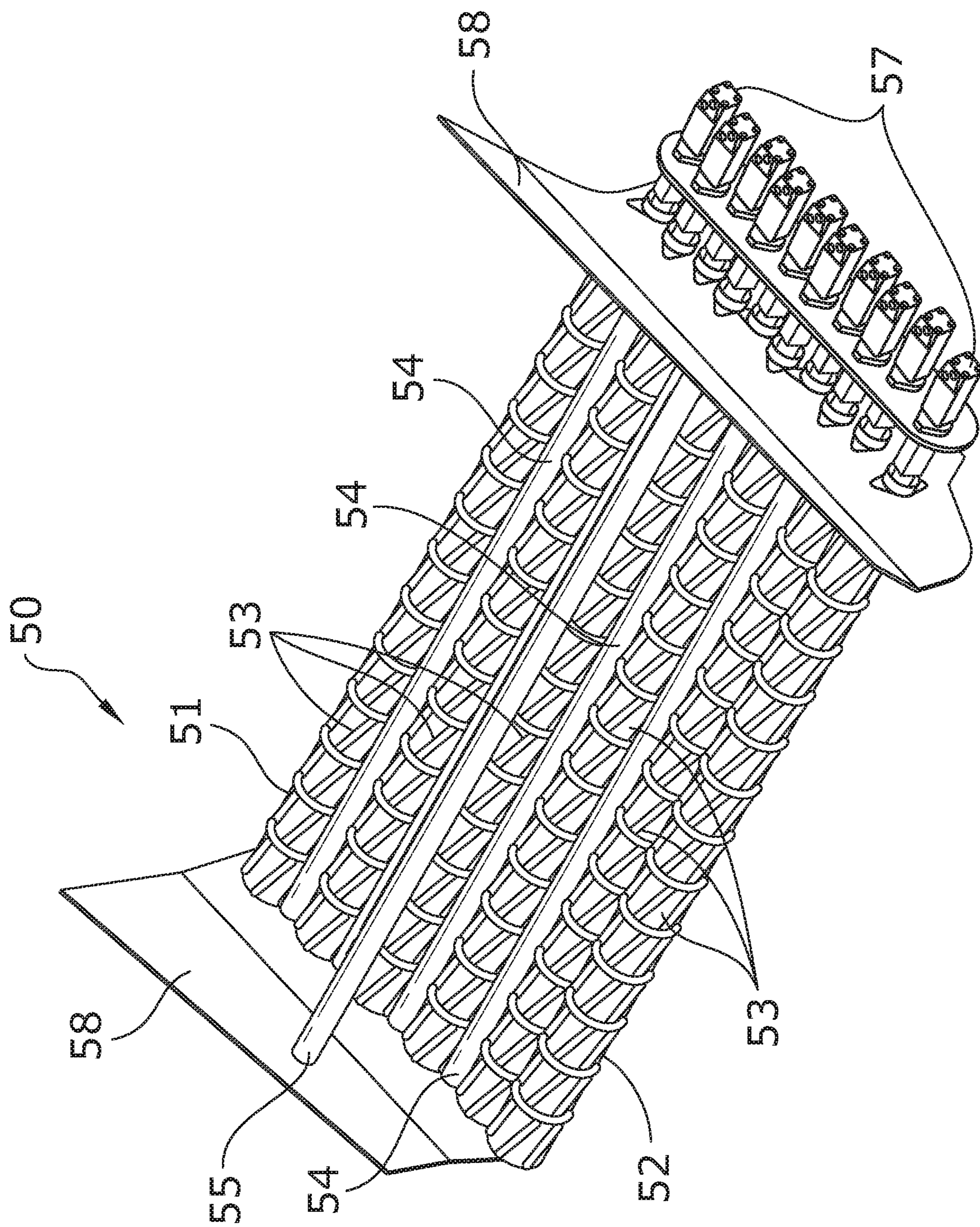


FIG. 5

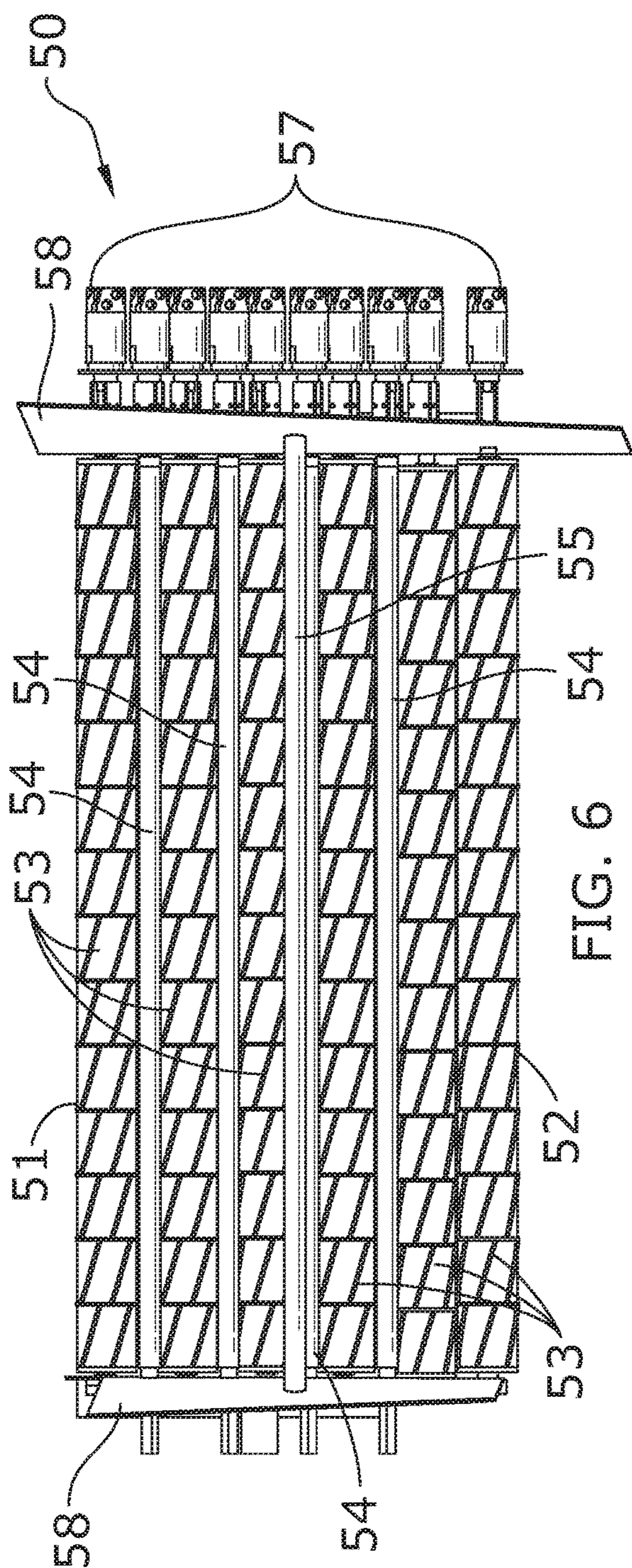


FIG. 6

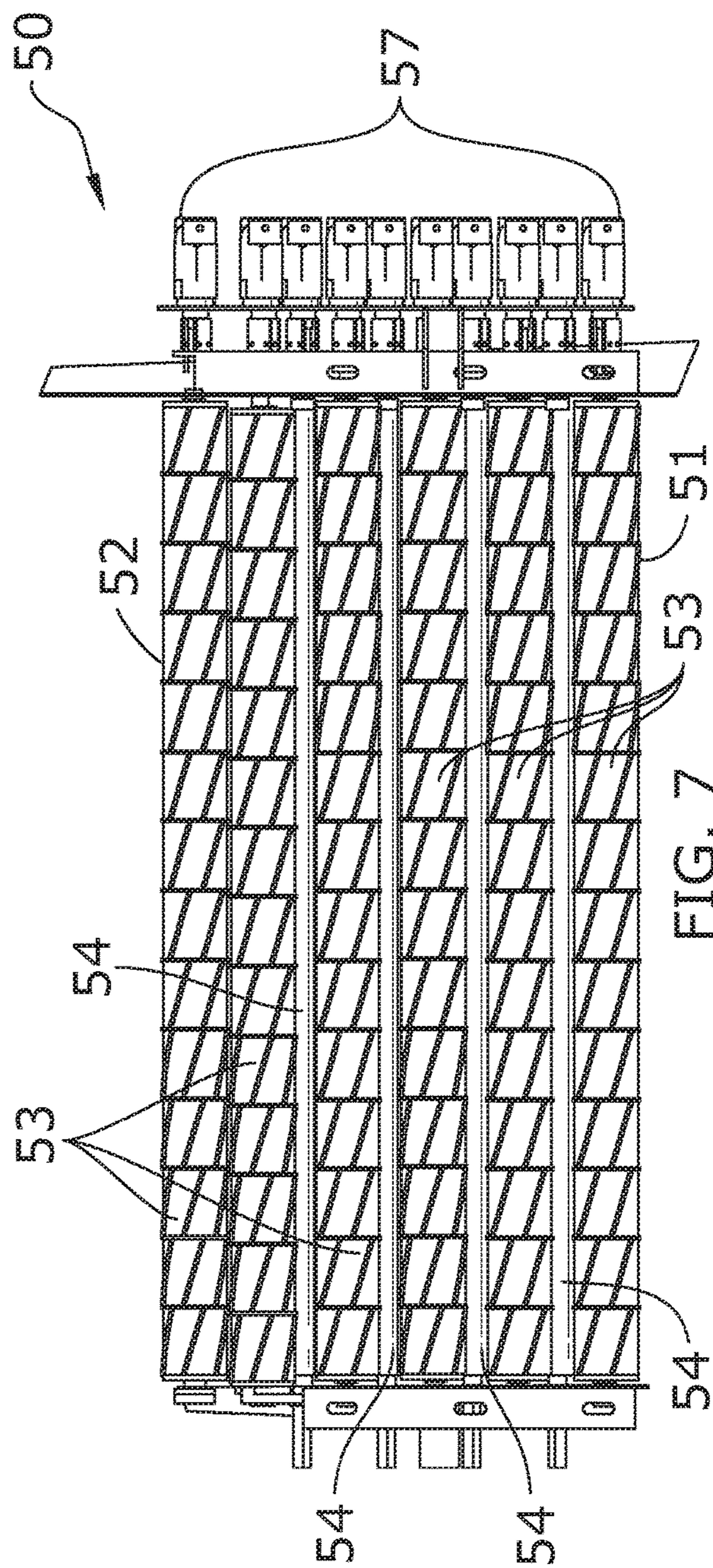


FIG. 7

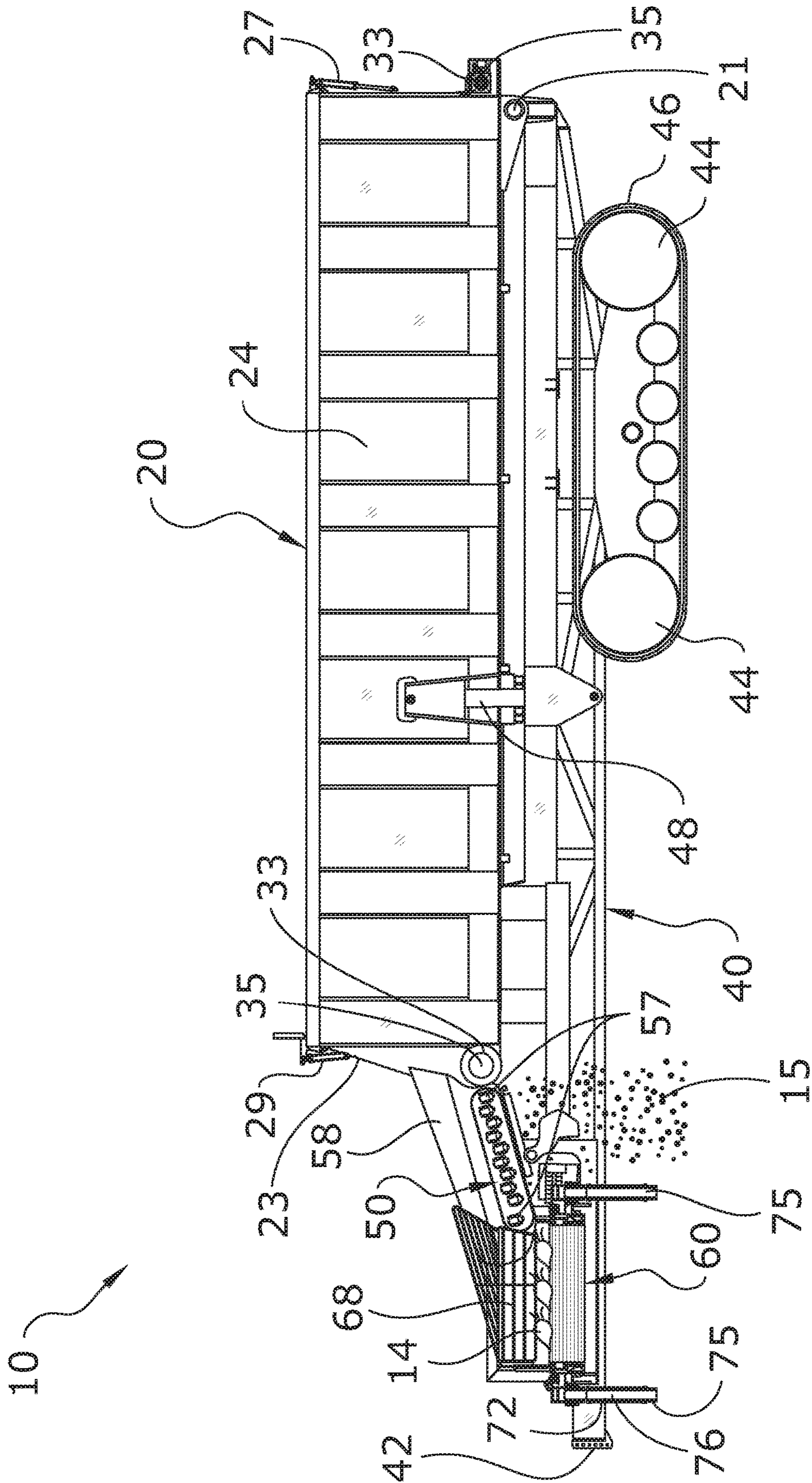


FIG. 8



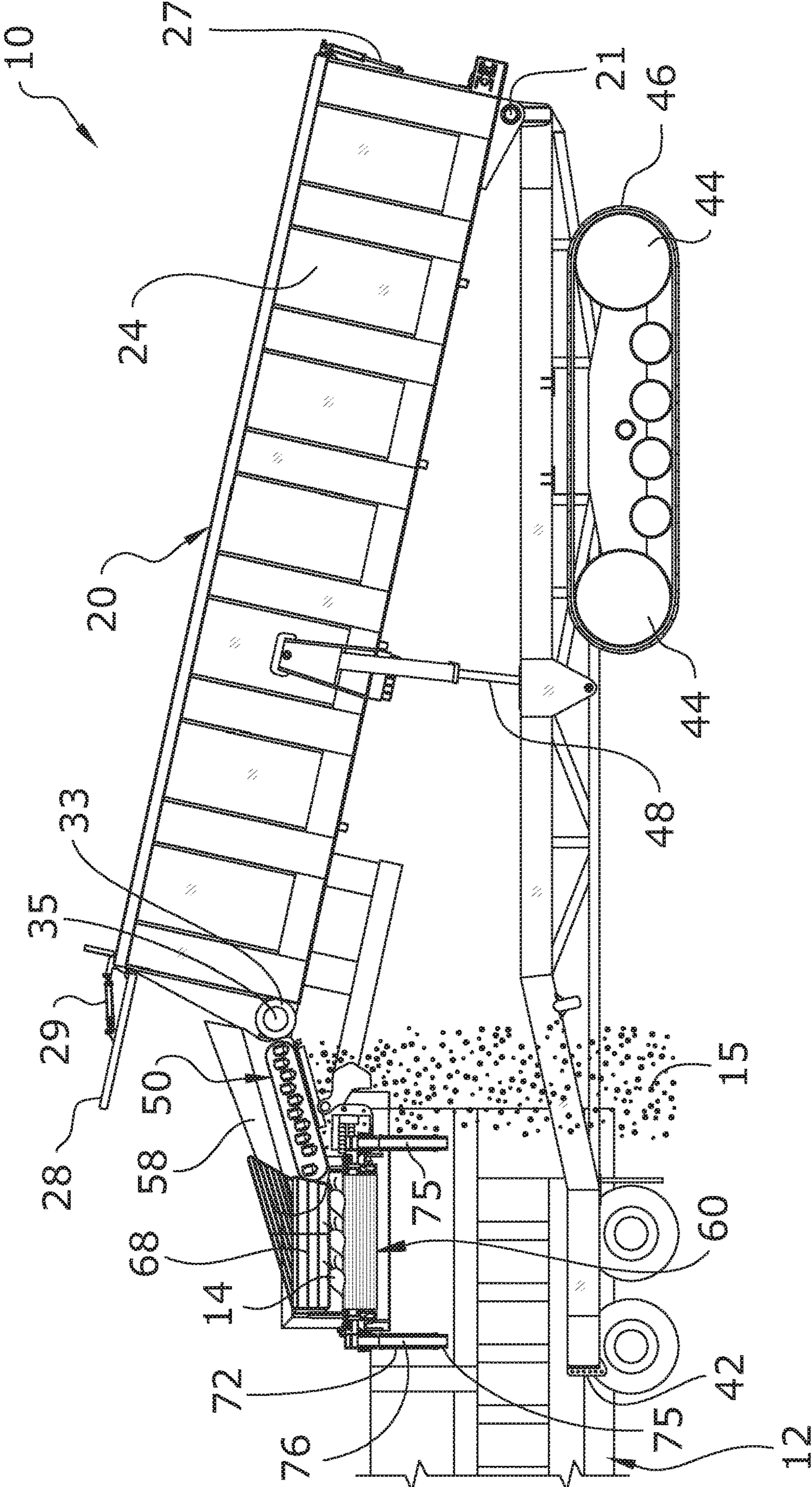


FIG. 9

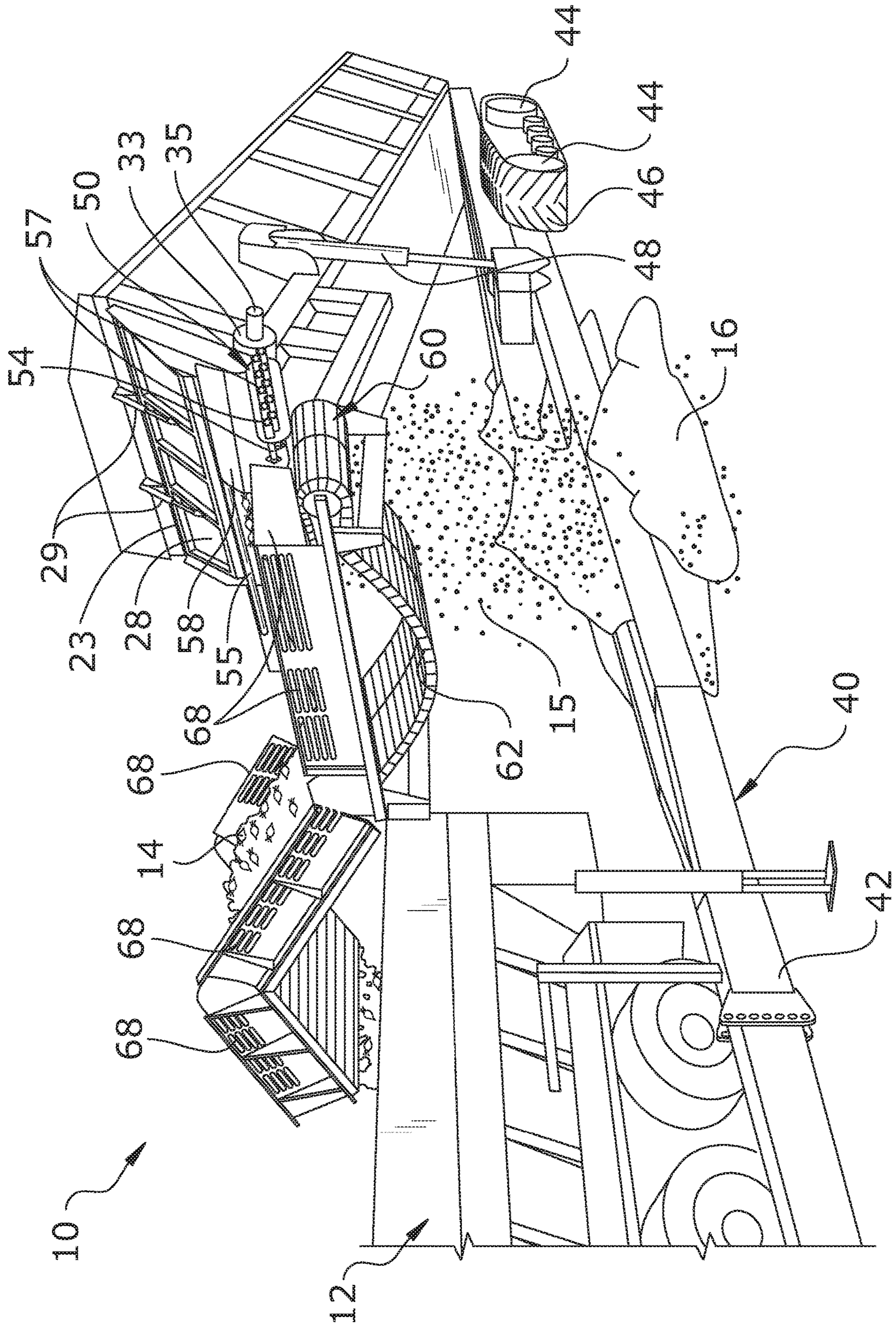


FIG. 10

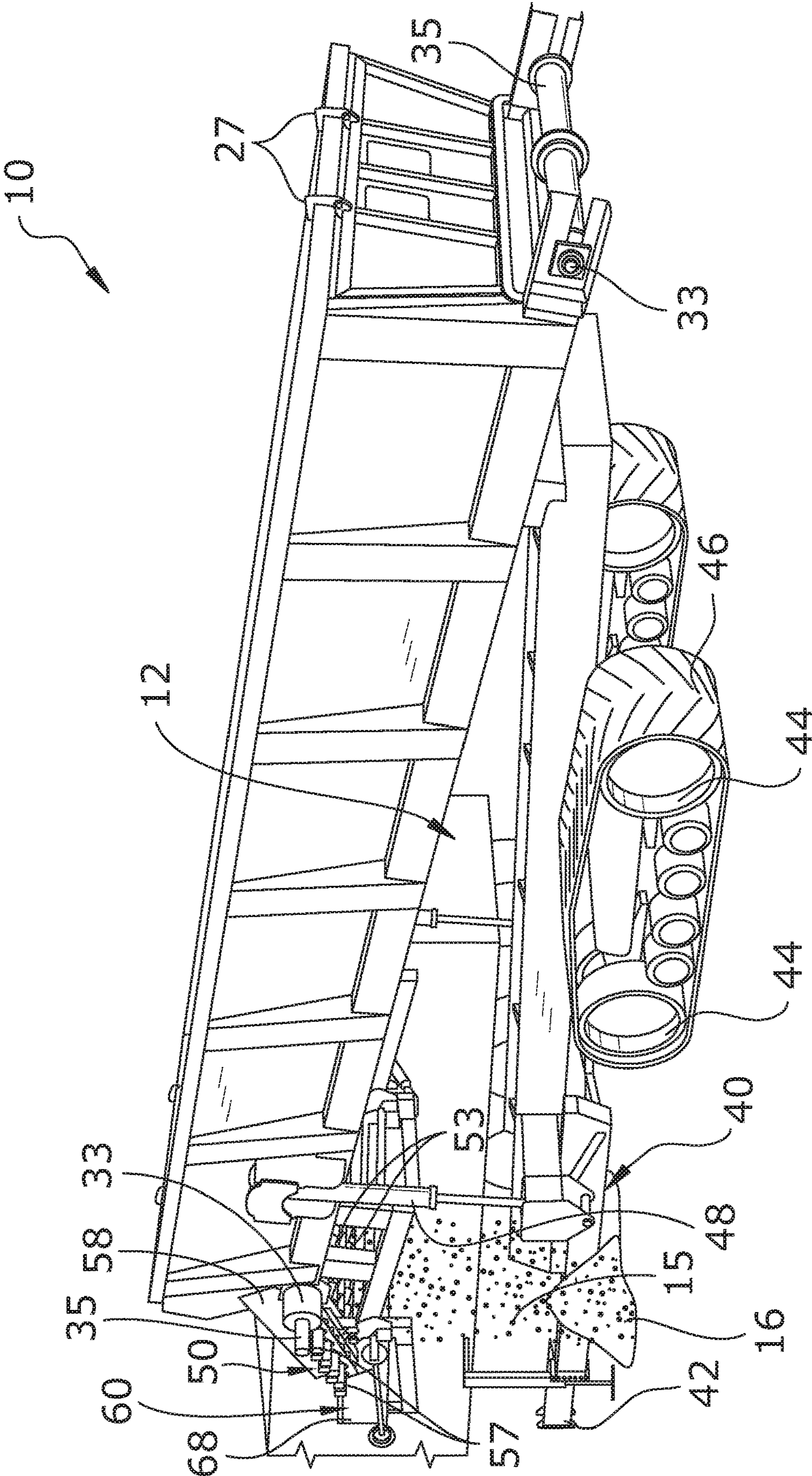


FIG. 11

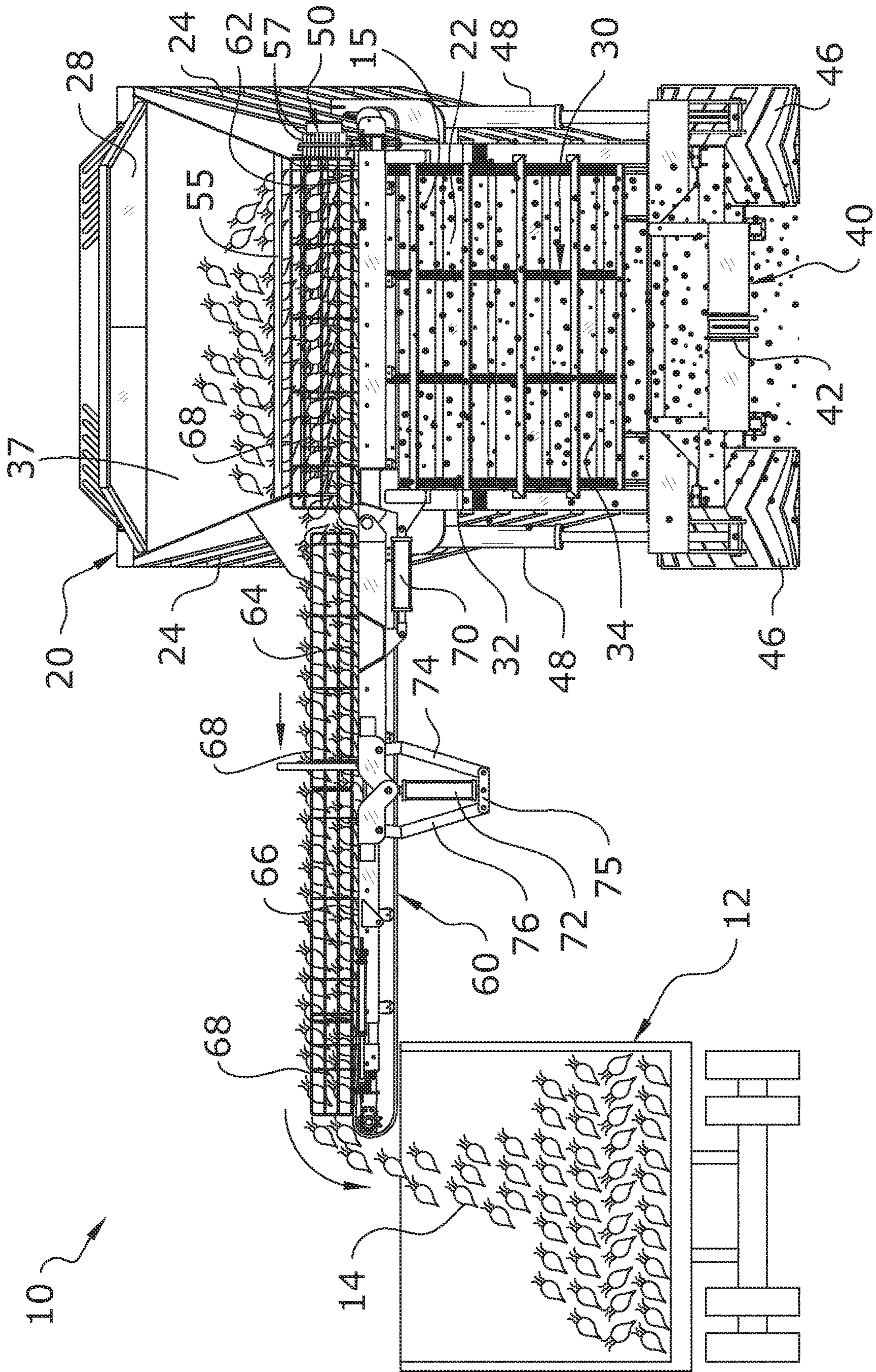


FIG. 12

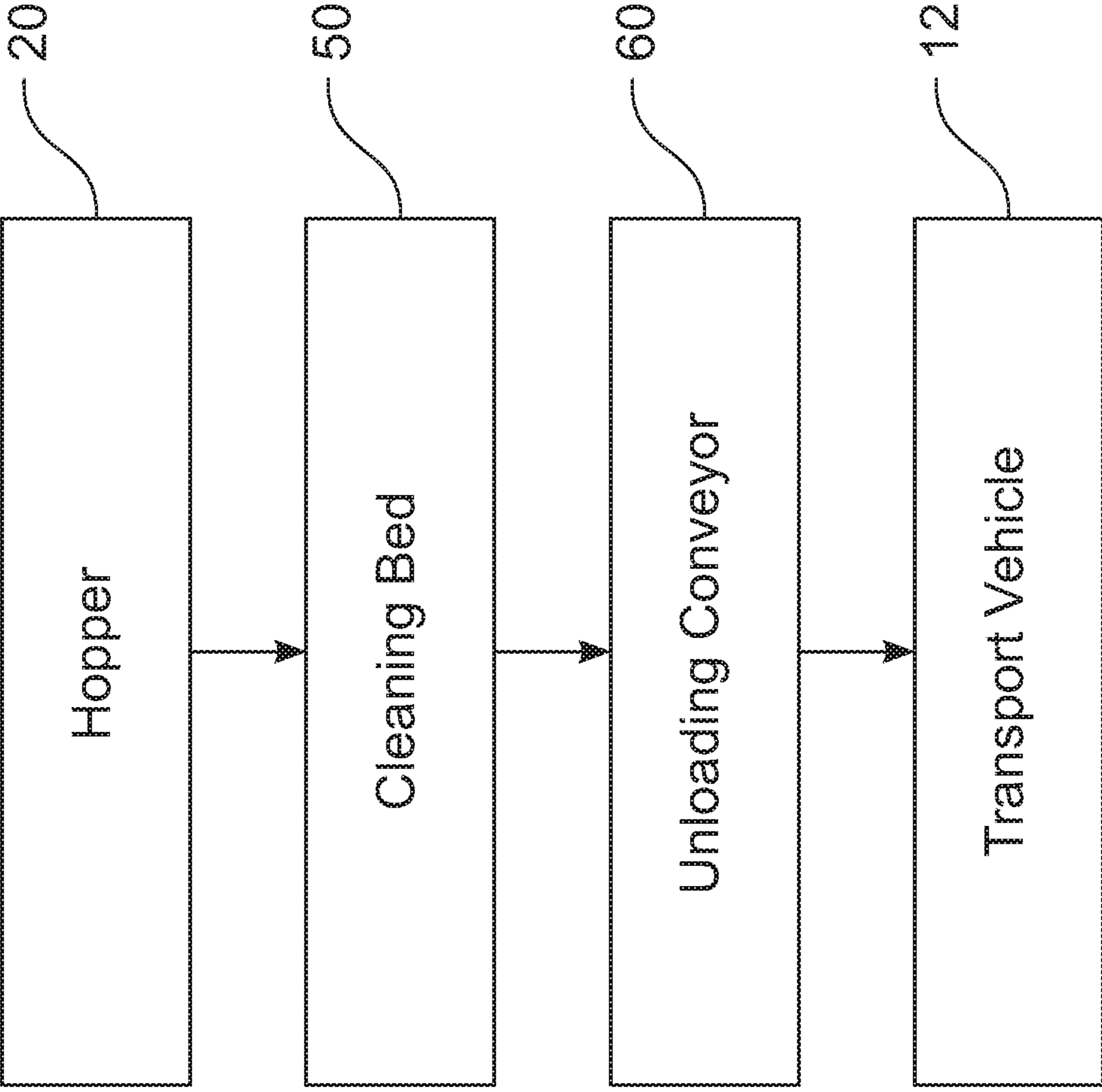


FIG. 13

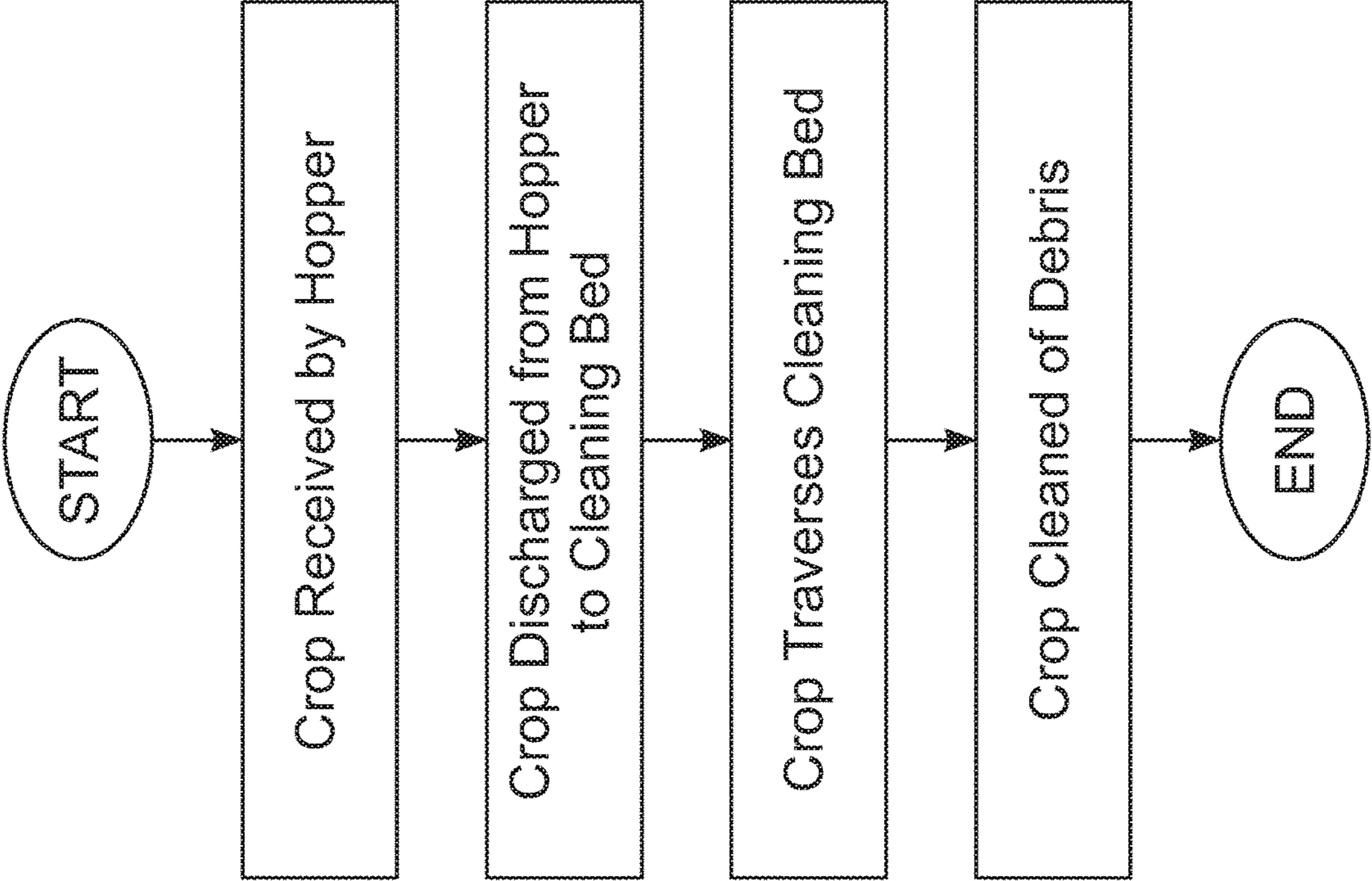


FIG. 14

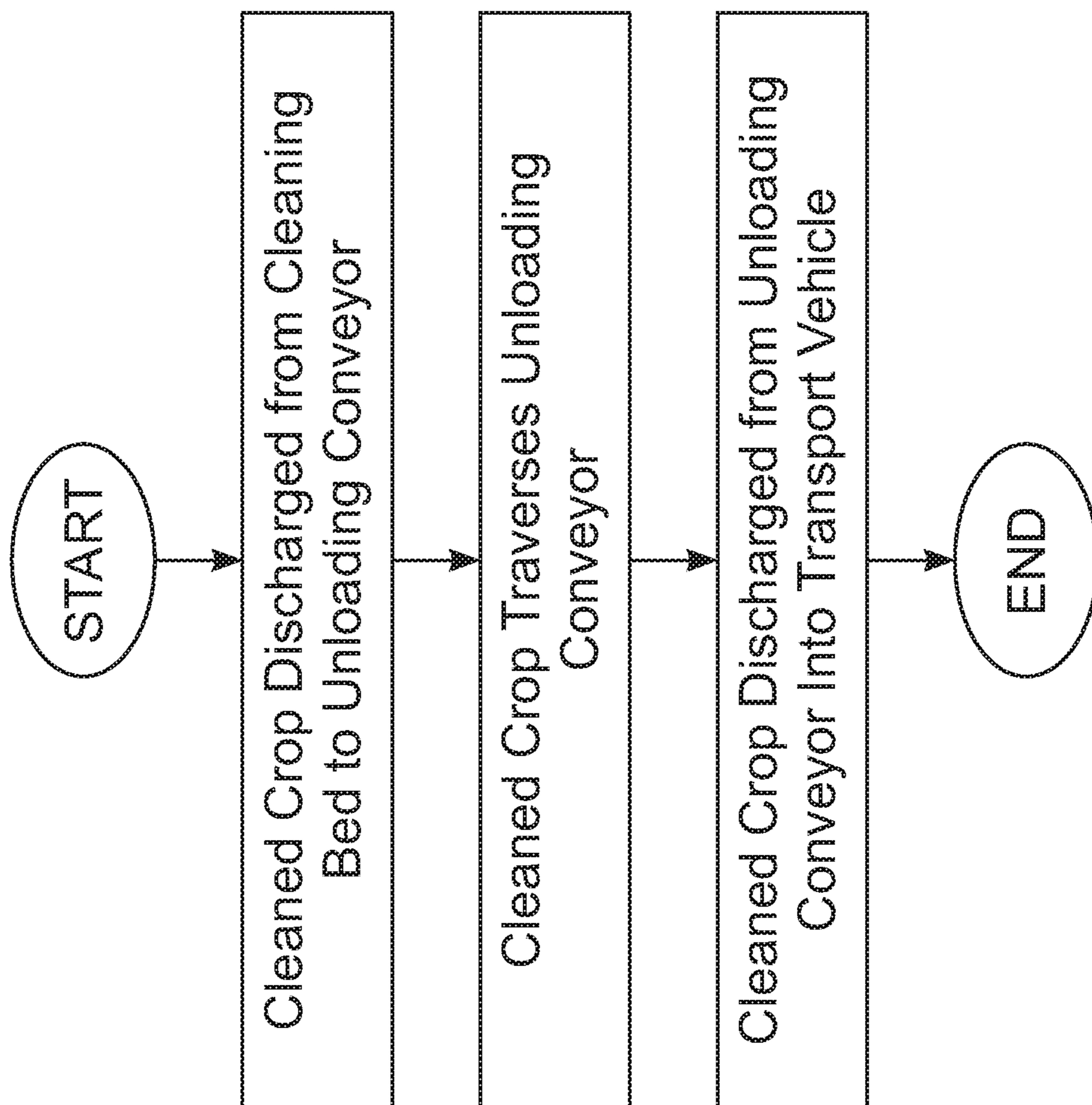


FIG. 15

## CROP CART CLEANING AND UNLOADING SYSTEM

### CROSS REFERENCE TO RELATED APPLICATIONS

**[0001]** The present application is a continuation of U.S. application Ser. No. 16/425,518 filed on May 29, 2019 which issues Jan. 28, 2020 as U.S. Pat. No. 10,542,677 (Docket No. KRIN-028). Each of the aforementioned patent applications, and any applications related thereto, is herein incorporated by reference in their entirety.

### STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

**[0002]** Not applicable to this application.

### BACKGROUND

#### Field

**[0003]** Example embodiments in general relate to a crop cart cleaning and unloading system for cleaning debris such as dirt and rocks from a crop as the crop is being transferred between a hopper of a crop cart and a transport vehicle.

#### Related Art

**[0004]** Any discussion of the related art throughout the specification should in no way be considered as an admission that such related art is widely known or forms part of common general knowledge in the field.

**[0005]** Crop carts are used to receive a crop from a harvester directly in the field during harvest. Crop carts can also be used to transport seed to a planter. Crop carts are typically used to receive, transport and unload various types of field crops such as, but not limited to, sugar beets, carrots, potatoes, onions, tomatoes, cucumbers, corn silage and the like.

**[0006]** Conventional crop carts are comprised of a trailer that is pulled by a tractor through the field next to the harvester. Conventional crop carts include an open topped hopper that receives various volumes of harvested crop from the harvester in real-time. When the hopper of the crop shuttle is full, the crop cart is transported to a location in the field to unload to a truck or other transport device using an unloading conveyor at the front of the hopper. The hopper includes a floor conveyor that moves the crop forwardly towards the unloading conveyor where the unloading conveyor is angled upwardly to lift the crop upwardly from the crop shuttle into the transport vehicle.

**[0007]** When using such conventional systems, the crop is generally transferred from harvester to crop cart to unloading conveyor to transport vehicle without any cleaning of debris from the crop except for that which is incidental to the crop's conveyance through the system. While it is certainly practical to clean the crop after unloading from the transport vehicle, the volume of crop capable of being stored by a particular transport vehicle is limited by the size of the transport vehicle. Typical crop that has just been harvested has a large amount of debris that can take up valuable space in the transport vehicle. The larger the amount of debris present on the crop when it is transferred into the transport vehicle, the more trips by the transport vehicle (or the more

transport vehicles) will be needed. It would thus be far more efficient to clean the crop of debris prior to the crop reaching the transport vehicle.

### SUMMARY

**[0008]** An example embodiment is directed to a crop cart cleaning and unloading system. The crop cart cleaning and unloading system includes a hopper for receiving a crop such as potatoes. The hopper transfers the crop onto a cleaning bed on which the crop is cleaned of debris, with the debris falling underneath the cleaning bed. The crop is conveyed across the cleaning bed as it is cleaned, with the cleaned crop being transferred from the cleaning bed onto an unloading conveyor. The unloading conveyor then transfers the cleaned crop to another location to be discharged, such as directly into a transport vehicle for further transport and processing.

**[0009]** There has thus been outlined, rather broadly, some of the embodiments of the crop cart cleaning and unloading system in order that the detailed description thereof may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional embodiments of the crop cart cleaning and unloading system that will be described hereinafter and that will form the subject matter of the claims appended hereto. In this respect, before explaining at least one embodiment of the crop cart cleaning and unloading system in detail, it is to be understood that the crop cart cleaning and unloading system is not limited in its application to the details of construction or to the arrangements of the components set forth in the following description or illustrated in the drawings. The crop cart cleaning and unloading system is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of the description and should not be regarded as limiting.

### BRIEF DESCRIPTION OF THE DRAWINGS

**[0010]** Example embodiments will become more fully understood from the detailed description given herein below and the accompanying drawings, wherein like elements are represented by like reference characters, which are given by way of illustration only and thus are not limitative of the example embodiments herein.

**[0011]** FIG. 1 is a perspective view of a crop cart cleaning and unloading system with the unloading conveyor in a retracted position in accordance with an example embodiment.

**[0012]** FIG. 2 is a perspective view of a crop cart cleaning and unloading system with the unloading conveyor in an extended position in accordance with an example embodiment.

**[0013]** FIG. 3 is a perspective view of a crop cart cleaning and unloading system in use in accordance with an example embodiment.

**[0014]** FIG. 4 is a rear perspective view of a crop cart cleaning and unloading system in accordance with an example embodiment.

**[0015]** FIG. 5 is a perspective view of a cleaning bed of a crop cart cleaning and unloading system in accordance with an example embodiment.



[0016] FIG. 6 is a top view of a cleaning bed of a crop cart cleaning and unloading system in accordance with an example embodiment.

[0017] FIG. 7 is a bottom view of a cleaning bed of a crop cart cleaning and unloading system in accordance with an example embodiment.

[0018] FIG. 8 is a side view of a crop cart cleaning and unloading system in use with the hopper at a horizontal orientation in accordance with an example embodiment.

[0019] FIG. 9 is a side view of a crop cart cleaning and unloading system in use with the hopper at an angled orientation in accordance with an example embodiment.

[0020] FIG. 10 is a frontal perspective view of a crop cart cleaning and unloading system in use in accordance with an example embodiment.

[0021] FIG. 11 is a rear perspective view of a crop cart cleaning and unloading system in use in accordance with an example embodiment.

[0022] FIG. 12 is a rear view of a crop cart cleaning and unloading system in use in accordance with an example embodiment.

[0023] FIG. 13 is a block diagram of a crop cart cleaning and unloading system in accordance with an example embodiment.

[0024] FIG. 14 is a flowchart illustrating the cleaning of debris from a crop by a crop cart cleaning and unloading system in accordance with an example embodiment.

[0025] FIG. 15 is a flowchart illustrating the transfer of cleaned crop to a transport vehicle by an unloading conveyor of a crop cart cleaning and unloading system in accordance with an example embodiment.

## DETAILED DESCRIPTION

### A. Overview

[0026] An example crop cart cleaning and unloading system 10 generally comprises a hopper 20 including an unloading end 23, a lower floor 22, and a plurality of sidewalls 24 extending upwardly from the lower floor 22, wherein the unloading end 23 is comprised of a front end or a rear end of the hopper 20, wherein the hopper 20 comprises an upper opening 38 defined by an upper end of the plurality of sidewalls 24 for receiving a crop 14 and an unloading opening 37 within the unloading end 23 adapted for unloading the crop 14 within the hopper 20. A cleaning bed 50 is connected to the hopper 20 so as to receive the crop 14 from the hopper, wherein the cleaning bed 50 is adapted to clean debris 15 from the crop 14 such that the debris 15 falls underneath the cleaning bed 50. An unloading conveyor 60 is connected to the cleaning bed 50 for conveying the crop 14 after the debris 15 has been cleaned from the crop 14 by the cleaning bed 50.

[0027] The hopper 20, the cleaning bed 50, and the unloading conveyor 60 may be connected in series. The cleaning bed 50 may be connected to the unloading end 23 of the hopper 20. The cleaning bed 50 may comprise a plurality of rollers 53, 54 and one or more roller drives 57 such as motors for rotating the plurality of rollers 53, 54. The plurality of rollers 53, 54 may comprise spiral rollers 53 having raised ribs and/or clod rollers 54 which are smooth and do not include raised ribs.

[0028] The cleaning bed 50 is adapted to convey the crop 14 in a first direction and the unloading conveyor 60 is adapted to convey the crop 14 in a second direction, with the

first direction being perpendicular to the second direction. A support frame 40 having a front end and a rear end may be provided, with the hopper 20 being pivotally connected to the support frame 40 near the front end or the rear end of the support frame 40.

[0029] A first end 51 of the cleaning bed 50 is connected underneath the unloading end 23 of the hopper 20 and a second end of the cleaning bed 50 is connected over the unloading conveyor 60. The cleaning bed 50 may be angled downwardly from the hopper 20 to the unloading conveyor 60.

[0030] Another example crop cart cleaning and unloading system 10 generally comprises a hopper 20 including an unloading end 23, a lower floor 22, and a plurality of sidewalls 24 extending upwardly from the lower floor 22, wherein the unloading end 23 is comprised of a front end or a rear end of the hopper 20, wherein the hopper 20 comprises an upper opening 38 defined by an upper end of the plurality of sidewalls 24 for receiving a crop 14 and an unloading opening 37 within the unloading end 23 adapted for unloading the crop 14 within the hopper 20. A cleaning bed 50 is connected to the hopper 20 so as to receive the crop 14 from the hopper 20, wherein the cleaning bed 50 is adapted to clean debris 15 from the crop 14, wherein the cleaning bed 50 comprises a plurality of rollers 53, 54 over which the crop 14 passes such that the debris 15 from the crop 14 falls between the plurality of rollers 53, 54 and underneath the cleaning bed 50. An unloading conveyor 60 is connected to the cleaning bed 50 for conveying the crop 14 after the debris 15 has been cleaned from the crop 14 by the cleaning bed 50, wherein a first end 51 of the cleaning bed 50 is connected underneath the unloading end 23 of the hopper 20 and a second end 52 of the cleaning bed 50 is connected over the unloading conveyor 60. The hopper 20 may comprise a floor conveyor 30 for conveying the crop 14 through the unloading opening 37 of the hopper 20.

[0031] Yet another example crop cart cleaning and unloading system 10 generally comprises a support frame 40 including a first track 46 or a first wheel 44 on a first side of the support frame 40 and a second track 46 or a second wheel 44 on a second side of the support frame 40 for movably supporting the support frame 40 upon a ground surface. A hopper 20 is pivotally connected to the support frame 40 near the front end or the rear end of the support frame 40, wherein the hopper 20 includes an unloading end 23, a lower floor 22, and a plurality of sidewalls 24 extending upwardly from the lower floor 22, wherein the unloading end 23 is comprised of a front end or a rear end of the hopper 20, wherein the hopper 20 comprises an upper opening 38 defined by an upper end of the plurality of sidewalls 24 for receiving a crop 14 and an unloading opening 37 within the unloading end 23 adapted for unloading the crop 14 within the hopper 20.

[0032] A cleaning bed 50 is connected to the hopper 20 so as to receive the crop 14 from the hopper 20, wherein the cleaning bed 50 is adapted to clean debris 15 from the crop 14, wherein the cleaning bed 50 comprises a plurality of rollers 53, 54 over which the crop 14 passes such that the debris 15 from the crop 14 falls between the plurality of rollers 53, 54 and underneath the cleaning bed 50, wherein the plurality of rollers 53, 54 are comprised of spiral rollers 53 and clod rollers 54. An unloading conveyor 60 is connected to the cleaning bed 50 for conveying the crop 14 after the debris 15 has been cleaned from the crop 14 by the

cleaning bed **50**, wherein a first end **51** of the cleaning bed **50** is connected underneath the unloading end **23** of the hopper **20** and a second end **52** of the cleaning bed **50** is connected over the unloading conveyor **60**.

[0033] The systems and methods described herein may be designed for receiving, transporting, cleaning, and unloading various types of crops **14** including field crops **14** such as, but not limited to, sugar beets, carrots, potatoes, onions, tomatoes, cucumbers, corn silage, and the like. It should also be appreciated that various non-field crops **14** may be supported, such as, but not limited to, apples, limes, lemons, oranges, and the like.

[0034] The systems and methods described herein may be utilized to receive, transport, and unload various types of crop seed. In further exemplary embodiments, various other types of non-crop materials may be received, transported, cleaned, and unloaded using the systems and methods described herein, such as, but not limited to, rocks, mined materials, bricks, and the like.

#### B. Support Frame

[0035] As best shown in FIGS. 1-4, a support frame **40** may provide support for a hopper **20**, with the hopper **20** being connected to the support frame **40**. It should be appreciated that, in some embodiments, a support frame **40** may be omitted, with the hopper **20** instead being positioned directly on the ground surface or mounted to a vehicle.

[0036] As shown in FIGS. 2 and 4, the support frame **40** may comprise a front end, a rear end, a right side, and a left side. The support frame **40** includes a longitudinal axis extending from the rear end to the front end of the support frame **40**. The support frame **40** may have various shapes and structures capable of supporting the hopper **20**.

[0037] The support frame **40** may include a plurality of wheels **44** rotatably attached to the side of the support frame **40** for movably supporting the support frame **40** above a ground surface. A first track **46** may surround the plurality of wheels **44** on the first side of the support frame **40** and a second track **46** may surround the plurality of wheels **44** on a second side of the support frame **40** such as shown in FIGS. 3 and 4.

[0038] The support frame **40** may include a hitch **42** adapted for removably connecting to a towing vehicle **13** such as a tractor as shown in FIG. 3. The support frame **40** may comprise any type of frame structure capable of supporting the hopper **20** in a movable manner in a wide range of locations, such as in a field, on a roadway, or a construction site.

#### C. Hopper

[0039] As best shown in FIGS. 1-4, 8, and 9, a hopper **20** is utilized to receive, store, transport, and unload various types of crop **14** or other materials. The hopper **20** may form part of a crop cart including a movable support frame **40** such as shown in FIGS. 8 and 9. The hopper **20** is illustrated as comprising a lower floor **22** and a plurality of sidewalls **24** extending upwardly from the lower floor **22** so as to define an interior cavity **25** that receives the crop **14** as shown in FIGS. 1-4.

[0040] The hopper **20** may comprise an elongated rectangular-shaped structure having a longitudinal axis extending from a rear end to a front end of the hopper **20** such as shown in FIGS. 1-4. The longitudinal axis of the hopper **20** may be

parallel to the longitudinal axis of a support frame **40** to which the hopper **20** may be connected.

[0041] As shown in FIGS. 1-4, an upper opening **38** is illustrated as being defined by an upper edge of the sidewalls **24** of the hopper **20**. The upper opening **38** receives the crop **14** to be stored in the hopper **20**. The crop **14** may be transferred through the upper opening **38** of the hopper **20** directly from a harvester (not shown) as the hopper **20** is pulled alongside the harvester in the field.

[0042] As shown in FIGS. 1 and 2, an unloading door **28** may be movably connected to an unloading end **23** of the hopper **20**. The unloading end **23** of the hopper **20** may comprise the front end or the rear end of the hopper **20**. In some embodiments, the unloading end **23** may comprise the first or second side of the hopper **20**.

[0043] The unloading door **28** may be used for allowing selective unloading of the crop **14** in the hopper **20**. The unloading door **28** may be manually opened and closed, such as by locks, clamps, straps, or the like, or may be powered such as shown in FIGS. 1 and 2. In some embodiments, the unloading door **28** may be omitted, with an exposed unloading opening **37** at the unloading end **23** of the hopper **20**.

[0044] In the exemplary embodiment of FIGS. 1 and 2, it can be seen that a pair of unloading actuators **29** are connected between the sidewalls **24** of the hopper **20** and the unloading door **28** so as to adjust the unloading door **28** between a closed position shown in FIG. 1 and an opened position as shown in FIG. 2. When the unloading door **28** is in the opened position, the unloading opening **37** is exposed so that the crop **14** may pass therethrough. It should be appreciated that in alternate embodiments, more or less unloading actuators **29** may be utilized. In some embodiments, a single unloading actuator **29** may be used.

[0045] As shown in FIG. 2, the unloading door **28** may be pivotally attached at an upper end thereof to or near the upper edge of the sidewalls **24**. The unloading door **28** may be positioned at the front end or the rear end of the hopper **20**. As shown in FIGS. 1 and 2, the unloading door **28** may swing downwardly to open and swing upwardly to close. The inverse configuration could also be utilized, with the unloading door **28** instead swinging upwardly to open and downwardly to close.

[0046] In some exemplary embodiments, the unloading door **28** may be freely rotatable such that the unloading door **28** opens as crop **14** is transferred out of the hopper **20**, with the crop **14** pushing the unloading door **28** open. In such embodiments, the unloading door **28** may be configured to automatically close, such as by force of gravity or by a biasing member, when no crops **14** are passing therethrough.

[0047] As shown in FIGS. 1 and 2, a floor conveyor **30** may be movably positioned with respect to the lower floor **22** so as to move the crop **14** in the hopper **20**. The crop **14** will generally be moved toward the unloading end of the hopper **20** by the floor conveyor **30**. The floor conveyor **30** may be driven by a drive motor, such as a hydraulic motor that is fluidly connected to the towing vehicle **13** pulling the hopper **20**. In such an embodiment, the speed of the floor conveyor **30** may be adjustably controlled from the towing vehicle **13**. The speed of the floor conveyor **30** may be increased to increase the volume and rate of the crop **14** being discharged from the unloading end of the hopper **20**, or may be decreased for the reverse effect.

[0048] The floor conveyor **30** may comprise a looped configuration in which the floor conveyor **30** is looped

around a pair of rotators **35** on either end of the hopper **20** such as shown in FIGS. **2** and **4**. Such a looped configuration forms an upper run of the floor conveyor **30** which traverses over the floor **22** of the hopper **20** and a lower run of the floor conveyor **30** that extends beneath the floor **22** of the hopper **20**.

[0049] The floor conveyor **30** may comprise a bar-type conveyor having a plurality of cross members **34** (with or without one piece rubber or flapped attachments) attached to chains **32** that extend transverse with respect to a movement path of the floor conveyor **30** as shown in FIGS. **1-4**. However, the floor conveyor **30** may be comprised of various other types of conveyors. In some embodiments, a floor conveyor **30** may be omitted entirely, with the hopper **20** instead being pivoted as discussed below such that gravity forces the crop **14** out of the unloading opening **37** rather than relying on a discrete floor conveyor **30**.

[0050] As shown in FIGS. **2-4**, the hopper **20** may be pivotally connected to the support frame **40** so as to allow the unloading end **23** to be lifted upwardly to an unloading position as shown in FIG. **2** and lowered downwardly to a loading position as shown in FIG. **1**. The hopper **20** may be pivotally connected near the front end or the rear end of the support frame **40**. In the exemplary embodiment shown in the figures, the hopper **20** is pivotally connected to the support frame **40** at or near the rear end of the support frame **40** with the unloading end **23** of the hopper **20** being located in the front as illustrated in FIGS. **1-4**.

[0051] The unloading end **23** of the hopper **20** may thus be near the front end of the support frame **40** such that the floor **22** of the hopper **20** is angled downwardly toward the unloading end **23** when in the unloading position. The hopper **20** may be pivotally connected to the support frame **40** by one or more hinges **21** connected to or near the rear end of the support frame **40** and to the rear portion of the hopper **20** as shown in FIG. **4**.

[0052] The floor **22** of the hopper **20** may be substantially horizontal when the hopper **20** is in the loading position as illustrated in FIG. **1**. The floor **22** may be comprised of a flat and level planar structure to allow the floor conveyor **30** to move along the upper surface of the floor **22**. The floor **22** of the hopper **20** is angled upwardly, preferably between 10 and 15 degrees towards the unloading end **23** when the hopper **20** is in the unloading position. When the unloading end **23** of the hopper **20** is at the front end, the floor **22** of the hopper **20** is angled upwardly, again at 10 to 15 degrees from the rear end of the hopper **20** to the front end of the hopper **20** as illustrated in FIGS. **2-4**.

[0053] The hopper **20** may also include a second door opposite of the unloading door **28** as shown in FIG. **4**. The figures illustrate a rear door **26** opened and closed by one or more corresponding rear actuators **27**. However, if the unloading door **28** is located in the rear portion of the hopper **20**, then the second door would be located at the front portion of the hopper **20**. The rear door **26** may be used to unload a crop **14** or other particulate material from the hopper **20** opposite of the unloading conveyor **60** by simply lifting the front end of the hopper **20** without moving the floor conveyor **30**.

[0054] One or more frame actuators **48** may be connected between the support frame **40** and the hopper **20**. In the exemplary embodiment shown in the figures, a pair of frame actuators **48** is connected to opposing side portions of the support frame **40** and the hopper **20** as illustrated in FIGS.

**3** and **4**. However a single frame actuator **48** may be used to lift and lower the hopper **20** between the loading position and the unloading position. The frame actuators **48** may be comprised of hydraulic actuators that are fluidly connected to the hydraulic system of the towing vehicle **13**, however, the frame actuators **48** may be comprised of electro-mechanical actuators or other types of actuators in different embodiments.

[0055] The frame actuators **48** are adapted to lift the unloading end **23** of the hopper **20** from a loading position into an unloading position. The loading position for the hopper **20** is for receiving the crop **14** into the hopper **20** and the unloading position for the hopper **20** is for unloading the crop **14** from the hopper **20**. However, as discussed below, in some embodiments the hopper **20** may be both loaded and unloaded in the “unloading position” wherein the hopper **20** is not angularly inclined but is instead horizontally-oriented.

[0056] The unloading end **23** of the hopper **20** may be near the front end of the hopper **20**, with the unloading door **28** being movably connected to the front end of the hopper **20** also to unload the field crop **14** from the front end of the hopper **20** when the front end of the hopper **20** is elevated at 10 to 15 degrees. The frame actuators **48** may be connected to a front portion of the hopper **20** to lift the front end of the hopper **20** and the unloading conveyor **60** upwardly.

#### D. Cleaning Bed

[0057] As shown throughout the figures, a cleaning bed **50** is connected between the hopper **20** and the unloading conveyor **60**. As crop **14** is discharged from the unloading end **23** of the hopper **20**, the crop **14** traverses over the cleaning bed **50** such that debris **15** is extracted by the cleaning bed **50** to clean the crop **14**. The debris **15** may fall underneath the cleaning bed **50** to form a debris pile **16** such as shown in FIGS. **10** and **11**.

[0058] The cleaning bed **50** serves to separate debris **15**, such as clod, stones, haulm, and loose soil, from a wide range of crop **14** such as but not limited to fruit, vegetables, and alliums, including potatoes, salad potatoes, sweet potatoes, onions, shallots, carrots, parsnips, celeriac, chicory, swedes, red beets, Brussel sprouts, flower bulbs, apples, bell peppers, and the like.

[0059] The shape, size, positioning, and orientation of the cleaning bed **50** may vary in different embodiments. In the exemplary embodiment shown in the figures, the cleaning bed **50** is illustrated as comprising a substantially rectangular shape including a first end **51** which receives the crop **14** and a second end **52** which discharges the crop **14** after being cleaned of debris **15**.

[0060] As shown in FIGS. **2** and **3**, the first end **51** of the cleaning bed **50** may be connected to the hopper **20** and the second end **52** of the cleaning bed **50** may be connected to the unloading conveyor **60**. Thus, crop **14** will be discharged from the unloading end **23** of the hopper **20**, such as by the floor conveyor **30** or by force of gravity if the hopper **20** is tilted, to be received by the first end **51** of the cleaning bed **50**.

[0061] The crop **14** will then traverse the cleaning bed **50** either by force of gravity or by conveyance using the rollers **53**, **54** described below. As the crop **14** traverses the cleaning bed **50**, debris **15** will be extracted such as by being shaken loose from the crop **14**. The debris **15** will fall through the cleaning bed **50**, such as between the rollers **53**, **54**. After traversing the cleaning bed **50**, the cleaned crop **14** will be

discharged from the second end **52** of the cleaning bed **50** onto the unloading conveyor **60** such as shown in FIG. 3.

[0062] As shown in FIGS. 1-3 and 8-13, the cleaning bed **50** is connected between the hopper **20** and the unloading conveyor **60**. The cleaning bed **50** receives crop **14** and debris **15** from the hopper **20**, cleans the debris **15** from the crop **14**, and then transfers the cleaned crop **14** to the unloading conveyor **60** for conveyance to a drop-off location, such as the ground surface, a stationary container, or a transport vehicle **12**.

[0063] The manner in which the cleaning bed **50** is connected between the hopper **20** and the unloading conveyor **60** may vary in different embodiments. While the figures illustrate the cleaning bed **50** being connected to the hopper **20**, it should be appreciated that the cleaning bed **50** may be individually supported without being connected directly to the hopper **20** and/or unloading conveyor **60**, such as by a frame. In such an embodiment, the cleaning bed **50** would be supported in an upright position between the hopper **20** and the unloading conveyor **60** such that the crop **14** is transferred from the hopper **20** onto the cleaning bed **50** and then subsequently transferred from the cleaning bed **50** onto the unloading conveyor **60**.

[0064] In other embodiments, the cleaning bed **50** may be connected to the hopper **20** and/or the unloading conveyor **60**, such as by welding, brackets, bolts, fasteners, straps, and the like. In some embodiments, the first end **51** of the cleaning bed **50** may be connected to the unloading end **23** of the hopper **20** and supported in a position with the second end **52** of the cleaning bed **50** being positioned over the unloading actuator **60**. In other embodiments, the second end **52** of the cleaning bed **50** may be connected to the unloading conveyor **60** and supported in apposition with the first end **51** of the cleaning bed **50** being positioned underneath the unloading end **23** of the hopper **20**.

[0065] In the exemplary embodiment shown in the figures, the first end **51** of the cleaning bed **50** is shown being connected to the unloading end **23** of the hopper **20**. The first end **51** of the cleaning bed **50** may be level with or underneath the unloading opening **37** of the hopper **20**, so long as crop **14** is easily transferred from the hopper **20** to the cleaning bed **50** by the floor conveyor **30** or force of gravity.

[0066] Continuing to reference the exemplary embodiment shown in the figures, the second end **52** of the cleaning bed **50** is shown being connected to the unloading conveyor **60**. The second end **52** of the cleaning bed **50** may be level with or positioned above the unloading conveyor **60**, so long as the crop **14** may be easily transferred from the cleaning bed **50** onto the unloading conveyor **60** after being cleaned of debris **15**.

[0067] The orientation of the cleaning bed **50** may vary in different embodiments. In the exemplary embodiment shown in the figures, the cleaning bed **50** is shown as being downwardly angled between the hopper **20** and the unloading conveyor **60**. More specifically, the first end **51** of the cleaning bed **50** is at a higher elevation than the second end **52** of the cleaning bed **50**, creating a slope to aid with transferring the crop **14** from the first end **51** of the cleaning bed **50** to the second end **52** of the cleaning bed **50** to be discharged onto the unloading conveyor **60**.

[0068] It should be appreciated that the angle of incline between the second end **52** of the cleaning bed **50** and the first end **51** of the cleaning bed **50** may vary in different

embodiments and thus should not be construed as limited by the exemplary figures. A higher angle of incline will increase rate and volume of crop **14** traversing the cleaning bed **50**. A lower angle of incline will have the reverse effect. In some embodiments, the cleaning bed **50** may be at a level incline.

[0069] Various types of cleaning beds **50** may be utilized so long as debris **15** may be effectively cleaned from a crop **14**, including but not limited to roller beds, roller tables, air separators, separators, star rollers, spiral rollers, clod rollers, and the like. In some embodiments, pressurized gasses such as air may be utilized to clear the debris **15** from the crop **14** when on the cleaning bed **50**. In other embodiments, pressurized fluids such as water may be utilized to clear the debris **15** from the crop **14**.

[0070] In the exemplary embodiment shown in the figures, the cleaning bed **50** is shown as comprising a plurality of rollers **53, 54** which rotate toward each other to entrain the debris **15** between adjacent rollers **53, 54** to be dispensed beneath the cleaning bed **50** while permitting the crop **14** to pass over the cleaning bed **50** and onto the unloading conveyor **60**. The number and spacing of the rollers **53, 54** may vary in different embodiments and should not be construed as limited by the exemplary figures. The rollers **53, 54** will generally be oriented transverse to the path of travel of the crop **14** such as shown in FIG. 2.

[0071] Various types of rollers **53, 54** may be utilized in different patterns and configurations. In the exemplary figures, both spiral rollers **53** having ribs and smooth clod rollers **54** not having ribs are shown as comprising the cleaning bed **50**. Each of the spiral rollers **54** may comprise a spiral rib which extends around the spiral roller **53** in a spiral configuration as shown in FIGS. 5-7. Each of the clod rollers **54** may comprise a smooth surface.

[0072] In the exemplary embodiment shown in the figures, it can be seen that the clod rollers **54** are positioned between pairs of spiral rollers **53**. Each pair of rollers **53, 54**, which may comprise either a pair of spiral rollers **53** or a spiral roller **53** and a clod roller **54**, are contra-rotating in that they rotate toward each other so as to drive debris **15** down through spaces between adjacent rollers **53, 54**. The debris **15** is then discharged underneath the cleaning bed **50** such as shown in FIGS. 8-10 and 12.

[0073] The rollers **53, 54** may be deformable so as to allow harder debris **15** such as stones to pass therebetween while retaining the larger crop **14**. The rollers **53, 54** may be spring-biased to momentarily separate from each other to allow larger rocks or other debris **15** to pass therebetween.

[0074] The rollers **53, 54** will generally be rotated while the cleaning bed **50** is in use. Generally, each adjacent pair of rollers **53, 54** will be contra-rotating, with the first of the pair of rollers **53, 54** rotating in a direction and the second of the pair of rollers **53, 54** rotating in a second, opposite direction toward the first of the pair of rollers **53, 54**. The manner in which the rollers **53, 54** are rotated may vary in different embodiments. In the exemplary embodiment shown in FIGS. 5-7, each roller **53, 54** is illustrated as being driven by a roller drive **57** at one end, with the other end being rotatably positioned within a roller bearing **56**.

[0075] The type of roller drive **57** may vary in different embodiments. For example and without limitation, the roller drives **57** may comprise a motor such as a hydraulic or electric motor. The roller drives **57** may be controlled from

within the towing vehicle 12, such as by electrical or hydraulic lines running from the towing vehicle 12 to the cleaning bed 50.

[0076] While the figures illustrate that each of the rollers 53, 54 includes its own roller drive 57, it should be appreciated that less roller drives 57 may be utilized. For example, with the use of cranks and/or gears, a single roller drive 57 could provide rotational force to all of the rollers 53, 54, with some rollers 53 being rotated in a first direction and other rollers 53, 54 being rotated in a second, opposite direction.

[0077] As shown in FIGS. 5-7, the cleaning bed 50 may include walls 58 between which the rollers 53, 54 extend. The walls 58 may be utilized to prevent the crop 14 from falling over either of the outer edges of the cleaning bed 50 when in use. Each of the walls 58 may extend from the first end 51 of the cleaning bed 50 to the second end 52 of the cleaning bed 50 such as shown in FIG. 5. The walls 58 may be inclined toward the cleaning bed 50 or may be vertically-oriented. The walls 58 of the cleaning bed 50 may overlap with the edge guards 68 of the unloading conveyor 60 such as shown in FIGS. 2 and 3 so as to prevent crop 14 from falling off the cleaning bed 50 before transferring to the unloading conveyor 60.

[0078] Similarly, the cleaning bed 50 may comprise an upper guard 55 as shown in FIGS. 2 and 5 which extends between the outer walls 58 of the cleaning bed 50 transverse to the direction of movement of the crop 14 through the cleaning bed 50. The upper guard 55 may comprise a rod or other elongated member which extends across the cleaning bed 50 at an elevated height with respect to the rollers 53, 54. If the crop 14 is stacked too high as it enters the cleaning bed 50, the guard 55 will push any crop 14 exceeding a set height limit back to smooth out any "hills" formed by clumps of crop 14 which can negatively impact the cleaning process.

#### E. Unloading Conveyor

[0079] The unloading conveyor 60 may be connected to the cleaning bed 50 and is adapted to receive and discharge a crop 14 received from the cleaning bed 50 after the crop 14 has been cleaned of debris 15. As shown in the figures, the unloading conveyor 60 may be connected beneath the cleaning bed 50, with the cleaning bed 50 extending partially over the unloading conveyor 60, such that cleaned crop 14 will fall off of the cleaning bed 50 and on to the unloading conveyor 60. The unloading conveyor 60 may be positioned at a lower elevation than the unloading end 23 of the hopper 20, with the cleaning bed 50 being angled downwardly between the hopper 20 and the unloading conveyor 60 as shown in FIG. 2.

[0080] The unloading conveyor 60 may be comprised of a bar-type conveyor belt having a plurality of cross bars and a plurality of slots, however, the unloading conveyor 60 may be comprised of various other types of conveyors. A drive motor moves the unloading conveyor 60 so the upper run of the unloading conveyor 60 moves the crop 14 in a first direction towards the discharge end of the unloading conveyor 60. The drive motor may be comprised of a hydraulic motor that is fluidly connected to the towing vehicle 13 pulling the hopper and with the speed of the unloading conveyor 60 adjustably controlled from the towing vehicle 13. The faster the unloading conveyor 60 moves a corre-

sponding increase in the volume of crop 14 discharged to the unloading conveyor 60 occurs and vice versa.

[0081] The unloading conveyor 60 has an upper run that moves the crop 14 to the discharge end of the unloading conveyor 60 to discharge the field crop 14 into a different vehicle or location. The unloading conveyor 60 also has a lower run that provides a return for the unloading conveyor 60. The longitudinal axis of the unloading conveyor 60 may be substantially transverse with respect to the longitudinal axis of the lower floor 22 of the hopper 20. In the exemplary figures, the longitudinal axis of the unloading conveyor 60 is perpendicular with respect to the longitudinal axis of the lower floor 22 of the hopper 20.

[0082] The angle between the longitudinal axis of the unloading conveyor 60 and the longitudinal axis of the cleaning bed 50 may vary in different embodiments. In some embodiments, the longitudinal axis of the unloading conveyor 60 may be transverse with respect to the longitudinal axis of the cleaning bed 50. In other embodiments, the longitudinal axis of the unloading conveyor 60 may be in line (linearly-oriented) with respect to the longitudinal axis of the cleaning bed 50. In such an embodiment, the crop 14 is conveyed in the same direction by both the cleaning bed 50 and the unloading conveyor 60.

[0083] In the exemplary embodiment of the figures, it can be seen that the longitudinal axis of the unloading conveyor 60 may be substantially perpendicular with respect to the longitudinal axis of the cleaning bed 50. In some embodiments, the unloading conveyor 60 may be oriented at a slight angle away from the cleaning bed 50, such as 5-10 degrees off perpendicular. For example, the angle between the longitudinal axis of the unloading conveyor 60 and the longitudinal axis of the cleaning bed 50 may comprise a 96 degree angle, which will result in the crop 14 being conveyed slightly away from the cleaning bed 50. Such a configuration may improve efficiency in both feeding and discharging the crop 14 with the unloading conveyor 60 and prevent jamming.

[0084] The proximal end of the unloading conveyor 60 may be positioned near one of the sidewalls 24 of the hopper 20 and the distal end of the unloading conveyor 60 may extend outwardly away from an opposite sidewall 24 to discharge the crop 14 at an elevated height to a transport vehicle 12 as shown in FIG. 3.

[0085] The unloading conveyor 60 may be downwardly angled from a rear edge to a front edge of the unloading conveyor 60 when the hopper 20 is in the loading position as best illustrated in FIG. 2. The unloading conveyor 60 is substantially horizontal from the rear edge to the front edge of the unloading conveyor 60 when the hopper 20 is in the unloading position as illustrated in FIG. 2. The angle of the unloading conveyor 60 with respect to the front end of the hopper 20 corresponds to the change in angle when the hopper 20 is elevated from the loading position to the unloading position so the unloading conveyor 60 is substantially level when unloading the crop 14.

[0086] The unloading conveyor 60 is comprised of an elongated structure having a longitudinal axis extending from a proximal end to a distal end. The unloading conveyor 60 is adapted to be horizontal from the proximal end to the distal end when the hopper 20 is in the unloading position. The longitudinal axis of the unloading conveyor 60 may be substantially transverse, such as but not limited to perpendicular, with respect to a longitudinal axis of the hopper 20.

An upper end of the unloading conveyor 60 is positioned at or below the upper edge of the plurality of side walls when the hopper 20 is in the loading position to reduce the chance of engagement with the crop harvester or other equipment.

[0087] The unloading conveyor 60 may be comprised of a folding conveyor as illustrated in the exemplary figures. As shown, the unloading conveyor 60 is comprised of a first segment 62 attached to the unloading end 23 of the hopper 20, a second segment 64 pivotally connected to a distal end of the first segment 62, and a third segment 66 pivotally connected to a distal end of the second segment 64 as best illustrated in FIG. 1.

[0088] The first segment 62 has a first frame, the second segment 64 has a second frame and the third segment 66 has a third frame that are independently movable with respect to one another in a pivotal manner. One or more inner actuators 70 are connected between the first segment 62 and the second segment 64 of the unloading conveyor 60 to extend and retract the second segment 64 with respect to the first segment 62 as shown in FIGS. 1 and 2. One or more outer actuators 72 are connected between the second segment 64 and the third segment 66 of the unloading conveyor 60 to extend and retract the third segment 66 with respect to the second segment 64.

[0089] One or more pivot frame structures pivotally support the pivot connection between the second segment 64 and the third segment 66. The pivot frame structures are each comprised of a first arm 74 pivotally connected to the second segment 64, a second arm 76 pivotally connected to the third segment 66, and a connecting member 75 pivotally connected between the arms 74, 76 as best illustrated in FIGS. 5c through 5e of the drawings. The outer actuators 72 are connected between the connecting member 75 and the pivot joint between the second segment 64 and the third segment 66.

[0090] As shown in FIGS. 2-4, each segment 62, 64, 66 of the unloading conveyor 60 may comprise edge guards 68 which prevent crop 14 from falling off the sides of the unloading conveyor 60 while being conveyed. The edge guards 68 may comprise sidewalls or the like which extend upwardly from the outer edges of the unloading conveyor 60 as shown in FIGS. 2-4. The edge guards 68 may be angled toward the unloading conveyor 60 or may be vertically-oriented. The edge guards 68 may be solid walls or may include openings.

#### F. Operation of Preferred Embodiment

[0091] FIG. 13 illustrates a block diagram of an exemplary embodiment of a crop cart cleaning and unloading system 10 which comprises a hopper 20, a cleaning bed 50, and an unloading conveyor 60 each being connected in a series configuration with each other. As shown in FIG. 14, the crop 14 is first received by the hopper 20, such as from a harvester in the field. The crop 14 is then transferred from the hopper 20, such as by inclining the hopper 20 or by use of a floor conveyor 30, to a cleaning bed 50. As the crop 14 traverses the cleaning bed 50, debris 15 such as rocks and soil are separated from the crop 14 and dropped underneath the cleaning bed 50 in a debris pile 16. As shown in FIG. 15, the cleaned crop 14 then exits the cleaning bed 50 onto an unloading conveyor 60, where it may be conveyed to be dropped off onto the ground surface, into a container, or into a transport vehicle 12.

[0092] In use, the hitch 42 of the support frame 40 is first connected to a towing vehicle 13 such as a tractor. The actuators 27, 29, 48, 70, 72 and roller drives 57 may be connected to the towing vehicle's 13 hydraulic system to allow operation of the various components of the system from within the towing vehicle 13. The operator may then board the towing vehicle 13 and transport the towing vehicle 13 and hopper 20 to a location to receive the crop 14.

[0093] The crop 14 may be received by the hopper 20 in a variety of manners. The hopper 20 may be moved in the field alongside a harvester (not shown), with the crop 14 being fed directly into the hopper 20 through the upper opening 38 from the harvester, such as by an auger, conveyor, or the like. In other embodiments, the hopper 20 may be stationary as it receives a load of crop 14. For example, the crop 14 could be dumped into a stationary hopper 20.

[0094] With the hopper 20 storing a volume of crop 14, the crop cart cleaning and unloading system 10 may be activated to both clean and unload the crop 14 from the hopper 20. The unloading door 28 on the unloading end 23 of the hopper 20 is opened to allow the crop 14 to be discharged through the unloading opening 37 of the hopper 20. The unloading door 28 may be opened manually, such as by lifting by an individual, or automatically, such as through use of one or more unloading actuators 29.

[0095] The manner in which the crop 14 is discharged may vary in different embodiments. In one exemplary embodiment, a floor conveyor 30 may be activated to convey the crop 14 toward the unloading end 23 of the hopper 20 and out of the unloading opening 37. In another exemplary embodiment, the end opposite to the unloading end 37 of the hopper 20 may be raised to an elevation, with the unloading end 37 remaining in place. In such a manner, the hopper 20 may be inclined toward the unloading end 37 such that the crop 14 is forced by gravity toward the unloading end 37 and out the unloading opening 37.

[0096] The manner in which the hopper 20 is inclined may vary in different embodiments. In the exemplary embodiment of the figures, one or more frame actuators 48 may be utilized to lift one end of the hopper 20 such as shown in FIG. 2. In other embodiments, the entire hopper 20 may be raised at a horizontal, level configuration by lifting both ends of the hopper 20 simultaneously. Such an embodiment may be utilized to adjust the height of the unloading opening 37 to account for the corresponding height of the transport vehicle 12 which eventually receives the crop 14 after being cleaned of debris 15.

[0097] In yet other embodiments, the hopper 20 may not be raised or inclined at all. In such embodiments, the hopper 20 may discharge the crop 14 even while at a level, horizontal orientation such as shown in FIG. 1 using the floor conveyor 30, rather than gravity, to force the crop 14 toward the unloading end 23 of the hopper 20.

[0098] With the hopper 20 conveying the crop 14 toward its unloading end 23, the cleaning bed 50 may be activated. When activated, the rollers 53, 54 of the cleaning bed 50 will be rotated or oscillated, such as by the roller drives 57. In one exemplary embodiment, each pair of adjacent rollers 53, 54 are contra-rotating such that each of the pair of rollers 53, 54 rotates toward the other of the pair of rollers 53, 54.

[0099] As the rollers 53, 54 are rotated, debris 15 from the crop 14 will be entrained in the spaces between each pair of adjacent rollers 53, 54. Dirt clods will be broken apart, and the debris 15 will be forced between the rollers 53, 54 to fall

underneath the cleaning bed 50. If the hopper 20 is in movement, the debris 15 will form a line which can be gathered later. If the hopper 20 is stationary, the debris 15 may form a debris pile 16 underneath the cleaning bed 50 that can be retrieved later.

[0100] The cleaning bed 50 will generally be tilted, with its receiving first end 51 being at a higher elevation than its discharging second end 52. In this manner, the crop 14 is conveyed from the first end 51 to the second end 52 of the cleaning bed 50 while being cleaned of debris 15 by rotating action of the rollers 53, 54. As shown in the figures, both the hopper 20 and the cleaning bed 50 may convey the crop 14 in the same direction, with the hopper 20 and cleaning bed 50 being linearly-oriented.

[0101] After being cleaned of debris 15, the cleaned crop 14 is transferred from the second end 52 of the cleaning bed 50 to the unloading conveyor 60. The figures illustrate that the unloading conveyor 60 moves in a direction which is transverse with respect to the direction of movement of both the floor conveyor 30 of the hopper 20 and the cleaning bed 50.

[0102] More specifically, as shown in FIG. 3, the direction of movement of the unloading conveyor 60 may be substantially perpendicular with respect to the direction of movement of the floor conveyor 30 and cleaning bed 50. By way of example and without limitation, the angle between the directions of movement of the unloading conveyor 60 and the cleaning bed 50 may range between 80 and 100 degrees. As a further example without imitation, the angle between the directions of movement of the unloading conveyor 60 and the cleaning bed 50 may comprise a 96 degree angle which is 6 degrees off perpendicular. In such an embodiment, the crop 14 is conveyed slightly away from the cleaning bed 50 by the unloading conveyor 60. In other embodiments, the angle may comprise a 90 degree angle (fully perpendicular).

[0103] In other embodiments, the unloading conveyor 60 may convey the crop 14 in the same direction as the hopper 20 and cleaning bed 50, or may convey the crop 14 in multiple directions. In such an embodiment in which the crop 14 is conveyed by the unloading conveyor 60 in the same direction as the hopper 20 and cleaning bed 50, the unloading conveyor 60 may be linearly-oriented in a straight line with respect to the cleaning bed 50.

[0104] The unloading conveyor 60 may be adjusted utilizing the inner and outer actuators 70, 72 to adjust the segments 62, 64, 66 of the unloading conveyor 60 to a desired orientation. The distal end of the unloading conveyor 60 may be positioned over a transport vehicle 12 such that the cleaned crop 14 falls from the unloading conveyor 60 into the transport vehicle 12. Alternatively, a transport vehicle 12 may be omitted and the unloading conveyor 60 may instead unload the cleaned crop 14 onto a ground surface or into a stationary container.

[0105] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. Although methods and materials similar to or equivalent to those described herein can be used in the practice or testing of the crop cart cleaning and unloading system, suitable methods and materials are described above. All publications, patent applications, patents, and other references mentioned herein are incorporated by reference in their entirety to the extent allowed by applicable law and

regulations. The crop cart cleaning and unloading system may be embodied in other specific forms without departing from the spirit or essential attributes thereof, and it is therefore desired that the present embodiment be considered in all respects as illustrative and not restrictive. Any headings utilized within the description are for convenience only and have no legal or limiting effect.

What is claimed is:

1. A crop cart cleaning and unloading system, comprising:
  - a support frame having a front end and a rear end;
  - a hopper connected to the support frame, wherein the hopper includes an unloading end adapted for unloading a crop within the hopper, a lower floor, a plurality of sidewalls extending upwardly from the lower floor, and an upper opening defined by an upper end of the plurality of sidewalls, wherein the unloading end of the hopper is comprised of a front end or a rear end of the hopper;
  - a cleaning bed connected to the support frame in a position between the hopper and the unloading conveyor, wherein the cleaning bed is positioned near the unloading end of the hopper to receive the crop from the hopper, wherein the cleaning bed is adapted to clean debris from the crop such that the debris falls underneath the cleaning bed; and
  - an unloading conveyor connected to the cleaning bed for conveying the crop after the debris has been cleaned from the crop by the cleaning bed;
 wherein the hopper, the cleaning bed, and the unloading conveyor are connected in series.
2. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed comprises a plurality of rollers.
3. The crop cart cleaning and unloading system of claim 2, comprising one or more motors for rotating the plurality of rollers.
4. The crop cart cleaning and unloading system of claim 2, wherein the plurality of rollers are comprised of spiral rollers.
5. The crop cart cleaning and unloading system of claim 2, wherein the plurality of rollers are comprised of clod rollers.
6. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed is adapted to convey the crop in a first direction and the unloading conveyor is adapted to convey the crop in a second direction.
7. The crop cart cleaning and unloading system of claim 6, wherein the first direction is perpendicular to the second direction.
8. The crop cart cleaning and unloading system of claim 1, wherein the hopper is pivotally connected to the support frame near the front end or the rear end of the support frame.
9. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed is positioned underneath the unloading end of the hopper.
10. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed is positioned over the unloading conveyor.
11. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed is angled downwardly from the hopper to the unloading conveyor.
12. The crop cart cleaning and unloading system of claim 1, wherein the cleaning bed is connected to the hopper.
13. The crop cart cleaning and unloading system of claim 1, wherein the hopper comprises a floor conveyor.

**14.** A crop cart cleaning and unloading system, comprising:

a support frame having a front end and a rear end;  
 a hopper connected to the support frame, wherein the hopper includes an unloading end adapted for unloading a crop within the hopper, a lower floor, a plurality of sidewalls extending upwardly from the lower floor, and an upper opening defined by an upper end of the plurality of sidewalls, wherein the unloading end of the hopper is comprised of a front end or a rear end of the hopper;

a cleaning bed connected to the support frame in a position between the hopper and the unloading conveyor, wherein the cleaning bed is positioned near the unloading end of the hopper to receive the crop from the hopper, wherein the cleaning bed is adapted to clean debris from the crop such that the debris falls underneath the cleaning bed;

wherein the cleaning bed comprises a plurality of rollers over which the crop passes such that the debris from the crop falls between the plurality of rollers and underneath the cleaning bed; and

an unloading conveyor connected to the cleaning bed for conveying the crop after the debris has been cleaned from the crop by the cleaning bed, wherein a first end of the cleaning bed is connected underneath the unloading end of the hopper and a second end of the cleaning bed is connected over the unloading conveyor;

wherein the hopper, the cleaning bed, and the unloading conveyor are connected in series.

**15.** The crop cart cleaning and unloading system of claim **14**, wherein the plurality of rollers is comprised of spiral rollers.

**16.** The crop cart cleaning and unloading system of claim **14**, wherein the hopper comprises a floor conveyor.

**17.** The crop cart cleaning and unloading system of claim **16**, wherein the cleaning bed and the floor conveyor are each adapted to convey the crop in a first direction, wherein the unloading conveyor is adapted to convey the crop in a second direction.

**18.** The crop cart cleaning and unloading system of claim **17**, wherein the first direction is perpendicular to the second direction.

**19.** The crop cart cleaning and unloading system of claim **14**, comprising one or more motors for rotating the plurality of rollers.

**20.** A crop cart cleaning and unloading system, comprising:

a support frame including a first track or a first wheel on a first side of the support frame and a second track or a second wheel on a second side of the support frame for movably supporting the support frame upon a ground surface;

a hopper connected to the support frame, wherein the hopper includes an unloading end adapted for unloading a crop within the hopper, a lower floor, a plurality of sidewalls extending upwardly from the lower floor, and an upper opening defined by an upper end of the plurality of sidewalls, wherein the unloading end of the hopper is comprised of a front end or a rear end of the hopper;

a cleaning bed connected to the support frame in a position between the hopper and the unloading conveyor, wherein the cleaning bed is positioned near the unloading end of the hopper to receive the crop from the hopper, wherein the cleaning bed is adapted to clean debris from the crop such that the debris falls underneath the cleaning bed;

wherein the cleaning bed comprises a plurality of rollers over which the crop passes such that the debris from the crop falls between the plurality of rollers and underneath the cleaning bed, wherein the plurality of rollers are comprised of spiral rollers and clod rollers; and

an unloading conveyor connected to the cleaning bed for conveying the crop after the debris has been cleaned from the crop by the cleaning bed, wherein a first end of the cleaning bed is connected underneath the unloading end of the hopper and a second end of the cleaning bed is connected over the unloading conveyor;

wherein the hopper, the cleaning bed, and the unloading conveyor are connected in series.

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