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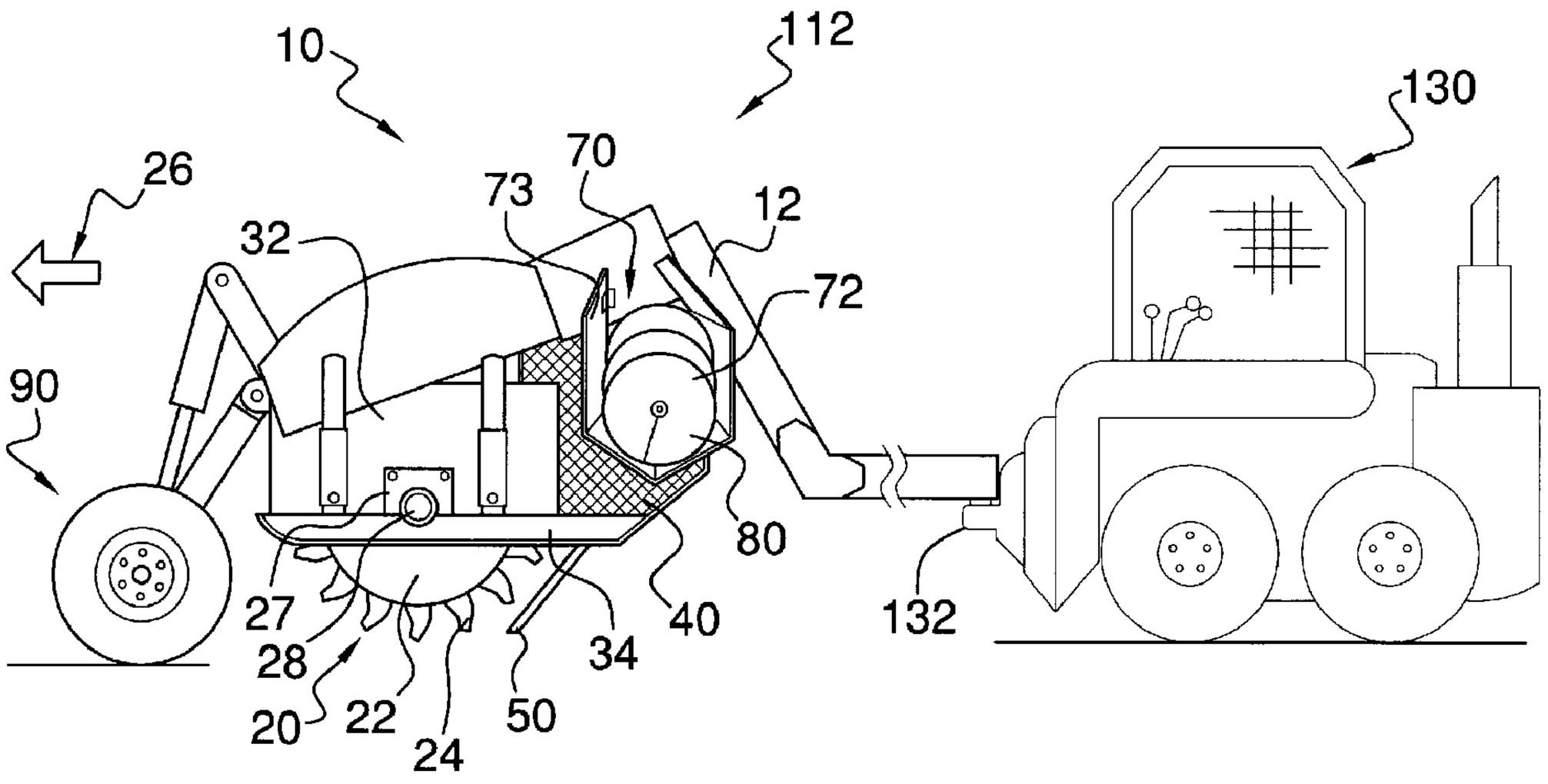
(54) Titre : ENGIN DE TERRASSEMENT QUI EFFECTUE CONSTAMMENT L'EXCAVATION D'UNE TRANCHE TOUT EN DEGAGEANT LES DEBLAIS DE LA TRANCHEE

(54) Title: AN EARTH MOVER WHICH CONTINUOUSLY EXCAVATES A TRENCH AND SIMULTANEOUSLY CLEARS THE EXCAVATED TRENCH OF SPOILS



(57) Abrégé/Abstract:
An earth mover for continuously excavating a trench and simultaneously clearing the excavated trench of spoils and depositing the spoils alongside the excavated trench. The earth mover including a cutter supported by a chassis in a rotatably drivable fashion about a cutter axis of rotation that is fixed relative to the chassis. A stripping blade having a stripping edge is disposed at a following position relative to the cutter and includes transport surface contiguous with a spoils collector. A spoils transfer assembly removes spoils from the spoils collector and deposits them alongside the excavated trench as the earth mover is propelled along a trenching path. Further included is a wheel support assembly secured to the chassis and including a pair of laterally spaced wheels providing ground support to the chassis. The wheels are rotatable about an axis relative to the chassis to position the chassis between ground engaging and transport positions.

ABSTRACT OF THE DISCLOSURE

An earth mover for continuously excavating a trench and simultaneously clearing the excavated trench of spoils and depositing the spoils alongside the excavated trench. The earth mover including a cutter supported by a chassis in a rotatably drivable fashion about a cutter axis of rotation that is fixed relative to the chassis. A stripping blade having a stripping edge is disposed at a following position relative to the cutter and includes transport surface contiguous with a spoils collector. A spoils transfer assembly removes spoils from the spoils collector and deposits them alongside the excavated trench as the earth mover is propelled along a trenching path. Further included is a wheel support assembly secured to the chassis and including a pair of laterally spaced wheels providing ground support to the chassis. The wheels are rotatable about an axis relative to the chassis to position the chassis between ground engaging and transport positions.

AN EARTH MOVER WHICH CONTINUOUSLY EXCAVATES A TRENCH AND SIMULTANEOUSLY CLEARS THE EXCAVATED TRENCH OF SPOILS

FIELD OF THE INVENTION

[001] The present invention relates generally to trench excavating and more particularly, to an earth mover which continuously excavates a trench and simultaneously clears the excavated trench of spoils and deposits the spoils alongside the excavated trench.

BACKGROUND OF THE INVENTION

[002] In pipeline operations where a pipeline is buried below the ground surface it is necessary to form a trench in the ground either during the process of laying the pipeline or to acquire access to a buried pipeline for service. In either of these instances, during trenching, the top soil must be removed from the underlying soil layers and stored separately to prevent contamination of the top soil. Further, it is desirable to form such a trench with low impact soil disturbance to minimize the amount of top soil that is stripped, and thus reduce the environmental impact caused by forming the trench.

[003] Accordingly, an earth mover of an improved construction allowing for controlled depth trench excavation for stripping and separating top soil from underlying soil layers is desired.

SUMMARY OF THE INVENTION

[004] The preferred embodiments of the present invention addresses this need by providing an earth mover which continuously excavates a trench and simultaneously clears the excavated trench of spoils and deposits the spoils alongside the excavated trench with low impact soil disturbance is provided.

[005] To achieve these and other advantages, in general, in one aspect, an earth mover is provided. The earth mover includes a chassis supported for transport across a ground surface in a travel direction in either a ground engaging position and a non-ground engaging position. The chassis is positioned in the ground engaging position during a trenching process. A cutter configured to form a rectilinear trench is supported by the chassis in a rotatably drivable fashion about a cutter axis of rotation that is fixed relative to the chassis. The earth mover further includes a spoils collector and a stripping blade having a stripping edge disposed at a following position relative to the cutter and having a transport surface contiguous with the spoils collector, wherein spoils cut by the cutter during the trenching process are transported along the transport surface and into the spoils collector. A spoils transfer assembly is supported by the chassis and includes a conveyor configured to remove spoils received in the spoils collector and to deposit the removed spoils along the side of a trench formed during the trenching process.

[006] There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof that follows may be better understood and in order that the present contribution to the art may be better appreciated.

[007] Numerous objects, features and advantages of the present invention will be readily apparent to those of ordinary skill in the art upon a reading of the following detailed description of presently preferred, but nonetheless illustrative, embodiments of the present invention when taken in conjunction with the accompanying drawings. The invention 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 descriptions and should not be regarded as limiting.

[008] As such, those skilled in the art will appreciate that the conception, upon which this disclosure is based, may readily be utilized as a basis for the designing of other structures, methods and systems for carrying out the several purposes of the present invention. It is important, therefore, that the claims be regarded as including such equivalent constructions insofar as they do not depart from the spirit and scope of the present invention.

[009] For a better understanding of the invention, its operating advantages and the specific objects attained by its uses, reference should be had to the accompanying

drawings and descriptive matter in which there are illustrated preferred embodiments of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010] The accompanying drawings, which are included to provide further understanding of the invention and are incorporated in and constitute a part of this specification, illustrate preferred embodiments of the invention and together with the description serve to explain the principles of the invention, in which:

[0011] Figure 1 is a side elevation of the earth mover, constructed in accordance with the principles of the present invention;

[0012] Figure 2 is a top plan view of the earth mover attached to a vehicle;

[0013] Figure 3 is a front elevation view of the earth mover in the non-ground engaging position;

[0014] Figure 4 is a bottom plan view of the earth mover, illustrating the cylindrical drum, stripping blade, and stripping edge;

[0015] Figure 5 is a bottom plan view of the earth mover, illustrating the adjustable length of the stripping edge;

[0016] Figure 6 is a side elevation view of the earth mover, illustrating the earth mover from the opposite side of FIG. 1, with the side surfaces removed, in operation; and

[0017] Figure 7 is a top plan view of the earth mover in operation.

DETAILED DESCRIPTION OF THE INVENTION

[0018] As a preliminary matter, it should be noted that in this document (including the claims) directional terms, such as "above", "below", "upper", "lower", "forward", "behind", etc., are used for convenience in referring to the accompanying drawings. Additionally, it is to be understood that the various embodiments of the present invention described herein may be utilized in various orientations, such as inclined, inverted, horizontal, vertical, etc., without departing from the principles of the present invention.

[0019] In FIGS. 1-3, there is representatively illustrated an earth mover 10 for continuously excavating a trench at a controlled depth to separate earth layers, for example, a top soil layer from underlying clay, and simultaneously clearing the top soil from the excavated trench and depositing the top soil alongside the excavated trench in a windrow 76. The earth mover 10 is particularly useful in pipeline operations where a trench must be formed with low soil impact disturbance and where the top soil needs to be separated from the underlying earth. It is important to note here, while the following description may be specific

to excavating a trench, the earth mover 10 could be used in other applications including, but not limited to, soil reclamation, stripping and mulching peat moss, removing top soil for sidewalks and the like, among others.

[0020] Still referring to FIGS. 1-3, the earth mover includes a chassis 12 supporting a cutter 20, a stripping blade 50, a spoils collector 40 and a spoils transfer assembly 70. A wheel support assembly 90 is mounted at one end of the chassis 12 and supports the chassis 12 on wheels 120. At an end opposite the wheel support assembly 90, the chassis 12 is provided with a hitch 132 or the like coupling for engaging the chassis to a vehicle 130 that tows or pushes the earth mover 10. Hitch 132 can be configured to engage the chassis to a towing ball, a hitch pin, a three-point hitch or the like of the vehicle 130. Further, the vehicle 130 could be, but is not limited to, a skid steer loader, an excavator, a front loader, a bulldozer or any other suitable vehicle.

[0021] Cutter 20 is supported by the chassis 12 in a rotatably drivable fashion on axel 28 about an axis of rotation 30. Cutter 20 is attached to axel 28 for conjoined rotation therewith. Opposite ends of the axel 28 are rotatably supported by bearing assemblies 27 mounted on opposite sides of chassis 12. A drive motor 38 is operatively coupled to axel 28, for example, by a chain drive assembly 29 for rotatably driving the axel 28 and thus the cutter 20 about axis 30. The drive motor 38 could be a hydraulic motor, an electric motor or a combustion engine. One of ordinary skill in the art will appreciate the chain drive assembly 29 could

be substituted with any number of drive assemblies for operatively connecting the drive motor 38 with axel 28 to rotatably drive the axel, and should not be limited to the chain drive assembly 29 as illustrated. As a non-limiting example, the axel 28, and thus cutter 20 could be driven by a power-takeoff of vehicle 130.

[0022] Cutter 20 is configured to form a rectilinear trench 74 when moved into an earth engaging position where the cutter 20 is plunged into the ground surface 118 and the earth mover 10 is moved along a trenching path. Cutter 20 comprises a cylindrical drum 22 having a circumferential exterior surface 23. A plurality of cutting teeth 24 are interspersed across the exterior surface 23 in a regular or irregular pattern. As illustrated, each cutting tooth 24 is a fixed carbide tooth. However, a person of ordinary skill in the art will appreciate the cutting teeth 24 can be of any suitable excavating tooth points, and should not be limited to fixed carbide teeth.

[0023] It is preferred the axis of rotation 30 to be generally normal to a travel direction 26 of the earth mover 10 during a trenching operation. However, it is contemplated the axis of rotation 30 could be swept forward or rearward relative to the travel direction 26.

[0024] Still referring to FIGS. 1-3, the earth mover 10 may further include a cutter shield 32, which partially encloses the cutter 20 and provides protection for an operator, or other person proximate to earth mover 10, from the cutter and/or excavating

debris. In one configuration, the cutter shield 32 substantially encloses the cutter 20 except a lower portion thereof permitting the cutter 20 to be engaged with the ground surface 118.

[0025] The earth mover 10 may further include a pair of sleds 34, 35 one located on each side of the chassis 12 below a respective bearing assembly 27. Sleds 34, 35 provide a depth stop to the chassis 12 to prevent lowering the chassis into the ground surface beyond a predetermined depth that otherwise may cause damage to the earth mover 10, and particularly to the bearing assembly 27. Sleds 34, 35 are configured to engage the ground surface along opposite sides of the earth mover 10 and an excavated trench. Sleds 34, 35 provide sliding support to the chassis 12 across the ground surface in the instance the chassis 12 is lowered beyond the predetermined depth. Sleds 34, 35 can be attached to the chassis 12 in a manner such that the sleds are vertically adjustable relative to the chassis. Additionally, sleds 34, 35 can be lowered to engage a ground surface to support the chassis 12 of the earth mover 10 when not operating.

[0026] Referring to FIG. 1 and 6 the inclined stripping blade 50 is supported by the chassis 12 for conjoint movement therewith. In other words, as the chassis 12 is lowered or raised, so is the stripping blade 50. Generally, the stripping blade 50 operates to plane the spoils from the excavated trench 74 and into the spoils collector 40. The stripping blade 50 includes a stripping edge 52 that is disposed in a following position 114 relative to the cutter 20, and in a trenching operation,

the stripping edge 52 strips the spoils from the bottom surface of the excavated trench. The stripped spoils are then transported along a transport surface 60 of the stripping blade 50 and into a spoils collector 40. In an embodiment, the transport surface 60 is contiguous with the spoils collector 40, such that the spoils are directed by the stripping blade 50 directly into the spoils collector as the earth mover 10 is moved forward in a trenching operation.

[0027] With reference to FIGS. 4 and 5, in an embodiment, the stripping edge 52 may be removably attached to a lower portion of stripping blade 50 by a bolted connection to permit replacement of a worn stripping edge 52. Further, the stripping edge 52 may be adjustably attached to the stripping blade 50 adjusted to a desired depth relative to the circumference of the cutter 20. As illustrated, the stripping blade 50 includes a plurality of parallel and spaced slots 56, and the stripping edge 52 includes an equal number of cooperatively aligned through holes 55. A bolt 54 extends each slot 56 and through hole 55 pair and is secured by a nut 57, thus securing the stripping edge 52 to the stripping blade 50. The position of the stripping edge 52 can be adjusted by loosening bolts 54, repositioning stripping edge 52 by sliding bolts 54 along the slots 56, and then subsequently retightening the bolts 54. The stripping edge 52 can be replaced by completely removing the bolts 54. The stripping blade 50 and/or stripping edge 52 substantially extends the entire the length of cylindrical drum 22, thereby planning the entire width of the trench excavated by the cutter. In this configuration, the spoils collector 40 receives substantially all of the spoils. It is

contemplated, in other embodiments, the stripping blade 50 and/or stripping edge 52 may extend less than the entire length of the cylindrical drum 22 as desired. Additionally, in embodiments, the stripping blade 50 may include lips (not pictured) extending along the transport surface 60 in a direction from the cutting edge 52 towards the spoils collector 40 to guide and retain spoils on the transport surface to minimizing spilling back into the excavated trench 74.

[0028] In alternate configurations, the stripping blade 50 could be comprised of multiple blades. In embodiments, multiple smaller blades could be staggered to cover the same surface areas as one larger stripping blade. Alternatively, multiple blades could be placed in series, with each blade following the previous blade, at a uniform or asymmetrical depth.

[0029] With reference to FIG. 1 and 6, spoils collector 40 is supported by chassis 12 and is located generally rearwardly of stripping blade 50. Spoils collector 40 operates to receive and collect spoils planed by stripping blade 50 and/or stripping edge 52, and thus transported along transport surface 60. Spoils received by spoils collector 40 are cached in a spoils receiving bay 71, an area of spoils collector 40 located behind the stripping blade 50 and operatively configured to receive and temporarily contain spoils awaiting transport from the conveyor 72.

[0030] Spoils collector 40 may further include a collector shield 68, which partially encloses spoils collector 40 such to contain the spoils received from the stripping

blade 50. In one configuration, the collector shield 68 substantially encloses the spoils collector except for a collector mouth 69, located at the lower portion of the spoils collector 40 for receiving spoils from the transport surface 60.

[0031] Referring to FIG. 6, the spoils transfer assembly 70 operates to remove spoils received by spoils collector 40 and deposit the spoils alongside the excavated trench 74 in a windrow 76. The spoils transfer assembly 70 is supported by chassis 12 of the earth mover 10, and is located generally rearwardly of the spoils collector 40. Additionally, in embodiments, the spoils transfer assembly 70 further operates to mulch the spoils as they are removed from the spoils collector 40 and deposited.

[0032] The spoils transfer assembly 70 includes a conveyor 72, further comprised of a receiving end 75 and a depositing end 77. The receiving end 75 is located within the spoils collector 40, positioned such to collect and remove the spoils contained within the spoils receiving bay 71 of spoils collector 40 and deposits such spoils into windrow 76. The spoils enter conveyor 72 at the receiving end 75 located inside of spoils receiving bay 71, from which they are transferred to along conveyor 72 to the depositing end 77. As illustrated, conveyor 72 is further comprised of a fixed section 84 and an articulated section 85, connected at an articulated joint 86. In this configuration, the articulated section 85 may be positioned at varying angles as required by the job performed. In one example, the

articulated section 85 may be raised when creating a deep trench, thus accommodating the amount of spoils created.

[0033] As illustrated, the conveyor 72 further includes an elongated auger 80 that is disposed within and along a trough 73. Auger 80 contains a universal joint 82 at approximately the same location as the articulated joint 86 of conveyor 72, allowing auger 80 to operate as articulated section 85 is angularly repositioned. The auger 80 is operated to transport the spoils from the spoils collector 40 along the trough 73 to depositing end 77, and to simultaneously mulch the spoils as they are transported along the trough 73. However, a person of ordinary skill in the art will realize alternative conveyors can be used to relocate spoils while remaining within the scope of the invention.

[0034] Conveyor 72 may be driven by a conveyor motor 78. The conveyor motor 78 could be a hydraulic motor, electric motor, or a combustion engine. Alternatively, conveyor 72 can be operatively coupled and driven by drive motor 38.

[0035] Trough 73 encloses the sides of conveyor 72, connecting to the lower portion of conveyor 72 and extending vertically. Inclusion of trough 73 provides containment of the spoils transported by conveyor 72, prevents spillage. In an alternate configuration, trough 73 may completely enclose conveyor 72.

[0036] With continued reference to FIGS. 2 and 3, the wheel support assembly 90 rests on the ground via wheels 120, supporting earth mover 10 as it moves in the travel direction 26. A drive axel 94 connects wheels 120, rotating within an axel sleeve 96. Right and left wheel support arms 92A and 92B attach to axel sleeve 96 at right and left support arm hubs 93A and 93B, respectively. Wheel support arms 92A and 92B pivot about wheel support pivot axis 122, further connected to the chassis 12 via support arm braces 91.

[0037] A hydraulic cylinder 105 is connected to the axel sleeve 96 via a hydraulic hub 95. Right and left hydraulic pivot braces 98A and 98B are attached to the hydraulic hub 95, allowing a hydraulic axel 97 to connect between the pivot braces 98A and 98B. A first end of the hydraulic cylinder 100 connects to hydraulic axel 97, allowing the hydraulic cylinder 105 to pivot about a first hydraulic axis 124. Similarly, a second end of the hydraulic cylinder 101 is connected to the chassis 12 via right and left hydraulic braces 102A and 102B, allowing hydraulic cylinder 105 to pivot about a second hydraulic axis 125. By allowing the hydraulic cylinder 105 to pivot about first and second hydraulic axes 124 and 125, the hydraulic system is able to adjust the trenching height of earth mover 10 by adjusting the length of which hydraulic piston extends from hydraulic cylinder 105.

[0038] In another embodiment, earth mover 10 could be self-propelled by an engine, drivetrain, and/or other required machinery known in the art, operatively attached

to drive connector 18 of chassis 12. The self-propelling machinery would be composed of an internal combustion, electric, or other machine.

[0039] In operation, earth mover 10 is capable of trenching and forming pipeline right-of-ways in areas where low impact soil disturbance is required. Earth mover 10 can remove topsoil, clay, frozen ground, rock, or other earth compositions from below the ground surface 118. Additionally, earth mover 10 is capable of performing all required processes necessary to move the earth in one pass. First, earth mover 10 breaks up the earth at the cutter 20, creating spoils ready for collection. Second, earth mover 10 collects the loosened spoils via the stripping blade 50. Third, earth mover 10 relocates the collected spoils to a convenient position within the spoils collector 40. Finally, the spoils transfer assembly 70 removes the spoils from the spoils collector 40, creating a windrow 76 of spoils.

[0040] Earth mover 10 can be set to ground engaging or non-ground engaging positions 110 and 112, respectively. During transportation or storage, earth mover 10 will generally be in the non-ground engaging position 112. Alternately, earth mover 10 will be in the ground engaging position 110 while creating trenches and moving earth. Since the height of cutter 20 is adjustable, earth mover 10 can be easily transported to and from different jobs. By altering the hydraulics on wheel support assembly 90, the operator can raise the cutter assembly 20 from the ground engaging position 110 to a sufficiently elevated non-ground engaging

position 112, such that earth mover 10 may be safely pushed or pulled to a new location.

[0041] From the non-earth engaging position 112, an operator initiates the apparatus by starting rotation of cutter's 20 cylindrical drum 22 to a speed sufficient to loosen the earth desired, such as 1000 RPM. At this time, the operator will also initiate conveyor 72 to allow the relocation of spoils to a convenient windrow 76. After initializing, the operator enters the ground engaging position 110 by lowering the cutter 20 to the desired cutting depth.

[0042] In the first stage of the trenching process 111, cutter assembly 20 engages the ground surface 118. The cutting teeth 24 of cutter 20 break up the earth as earth mover 10 moves forward in the travel direction 26. The operator may select which layers of earth (topsoil, subsoil, clay, etc.) he or she desires to remove by adjusting the cutting depth, via the hydraulics on the wheel support assembly 90.

[0043] Once the earth has been broken into spoils by cutter 20, the spoils encounter stripping blade 50. The stripping edge 52 of the stripping blade 50 planes the newly loosened spoils from the bottom of the trench 74. These spoils move up the inclined transport surface 60 of the stripping blade 50. Although the cutter 20 propels some spoils up the transport surface 60 through its rotating momentum, most spoils are taken by the stripping blade 50 as earth mover 10 travels forward

in the travel direction 26. The force the newly loosened spoils push the remaining spoils across the transport surface 60

[0044] Next, spoils are received by the spoils collector 40, where they gather in the spoils receiving bay 71. The spoils remain here temporarily, until they are removed by conveyor 72 of the spoils transfer assembly 70 and dropped into a windrow 76. Additionally, spoils removal by the spoils transfer assembly 70 prevents clogging of the spoils collector 40 that could be caused by to excessive spoils in the spoils receiving bay 71.

[0045] If the operator desires to refill a trench 74 with the spoils of a previously formed windrow 76, he or she would simply drive earth mover 10 over windrow 76. Stripping blade 50 would receive the already loosened spoils, delivering the spoils to spoils collector 40. Since the distance between the windrow 76 and the trench 74 would be unchanged, earth mover 10 effectively relocates the spoils from the windrow 76 back into the trench 74.

[0046] A number of embodiments of the present invention have been described. Nevertheless, it will be understood that various modifications may be made without departing from the spirit and scope of the invention. Accordingly, other embodiments are within the scope of the following claims.

CLAIMS

1. An earth mover comprising:

a chassis supported for transport across a ground surface in a travel direction in either a ground engaging position and a non-ground engaging position, said chassis being positioned in the ground engaging position during a trenching process;

a cutter supported by said chassis in a rotatably drivable fashion about a cutter axis of rotation, said cutter configured to form a rectilinear trench during said trenching process, said axis of rotation being fixed relative to said chassis;

a spoils collector;

a stripping blade having a stripping edge disposed at a following position relative to said cutter and having a transport surface contiguous with said spoils collector, wherein spoils cut by said cutter during said trenching process are transported along said transport surface and into said spoils collector; and

a spoils transfer assembly supported by said chassis, said spoils transfer assembly comprising a conveyor configured to remove spoils received in said spoils collector and to deposit the removed spoils along the side of a trench formed during said trenching process.

2. The earth mover of claim 1, further comprising:

a wheel support secured to said chassis, said wheel support having a lateral axis, and laterally spaced wheels providing ground support and supported by said wheel support for rotation about said lateral axis between raised and lowered positions relative to said cutter.

3. The earth mover of claim 1, wherein said stripping blade is supported by said chassis for conjoined movement therewith between the ground engaging and non-ground engaging positions.

4. The earth mover of claim 1, wherein said stripping blade is supported by said chassis.

5. The earth mover of claim 1, wherein said conveyor is an auger.

6. The earth mover of claim 1, wherein said stripping edge extends substantially the length of said cutter.

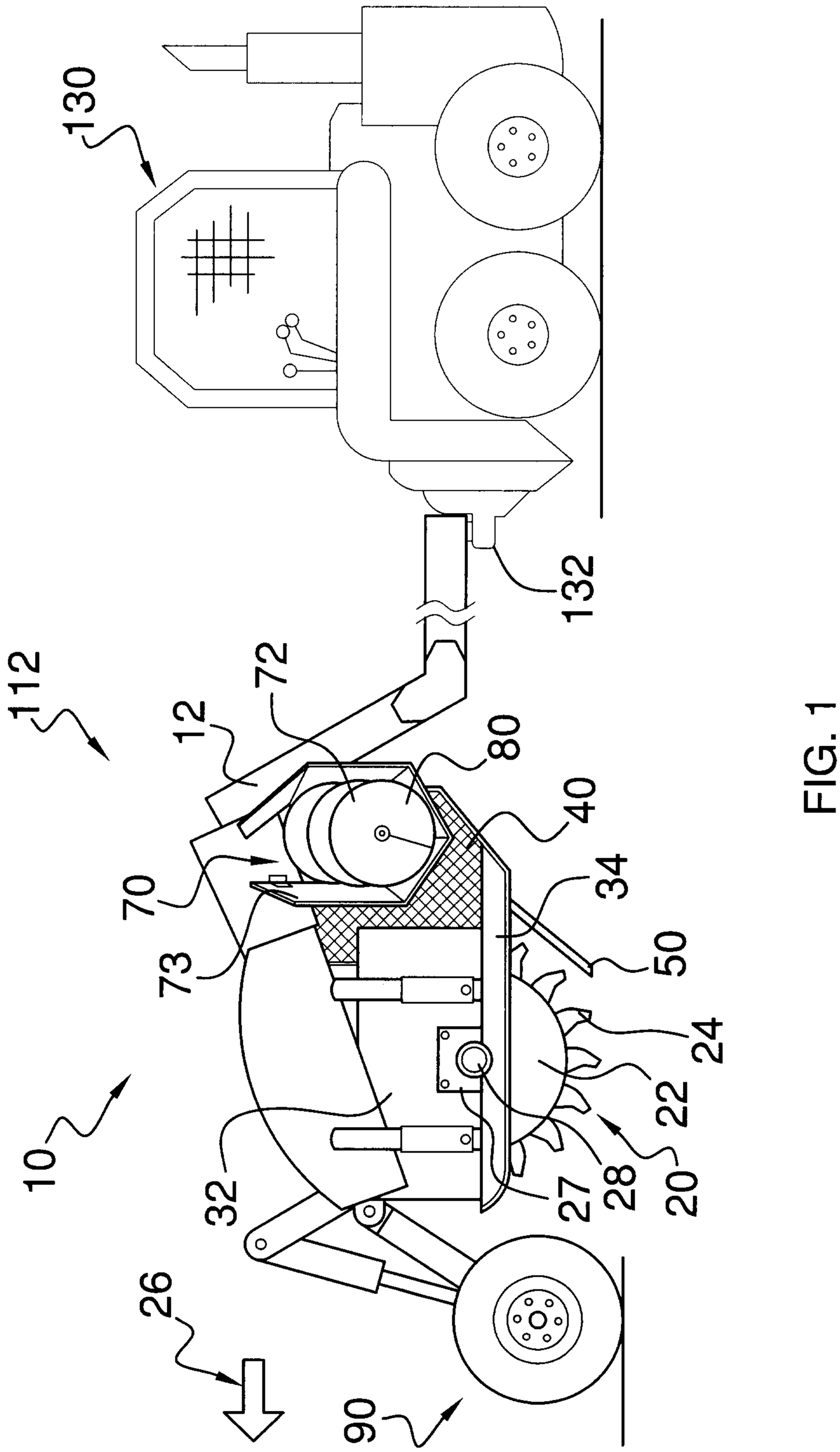
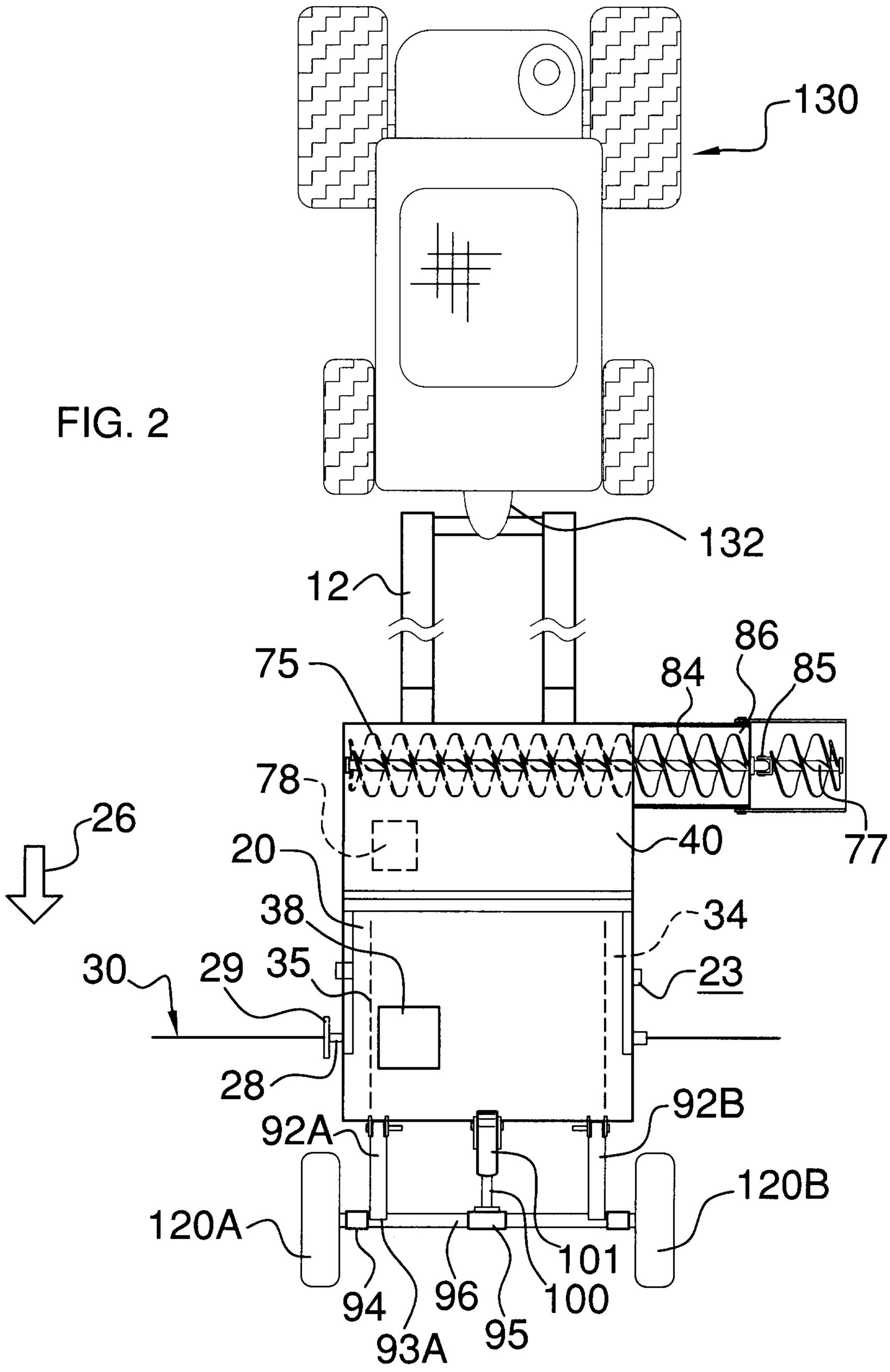


FIG. 1

FIG. 2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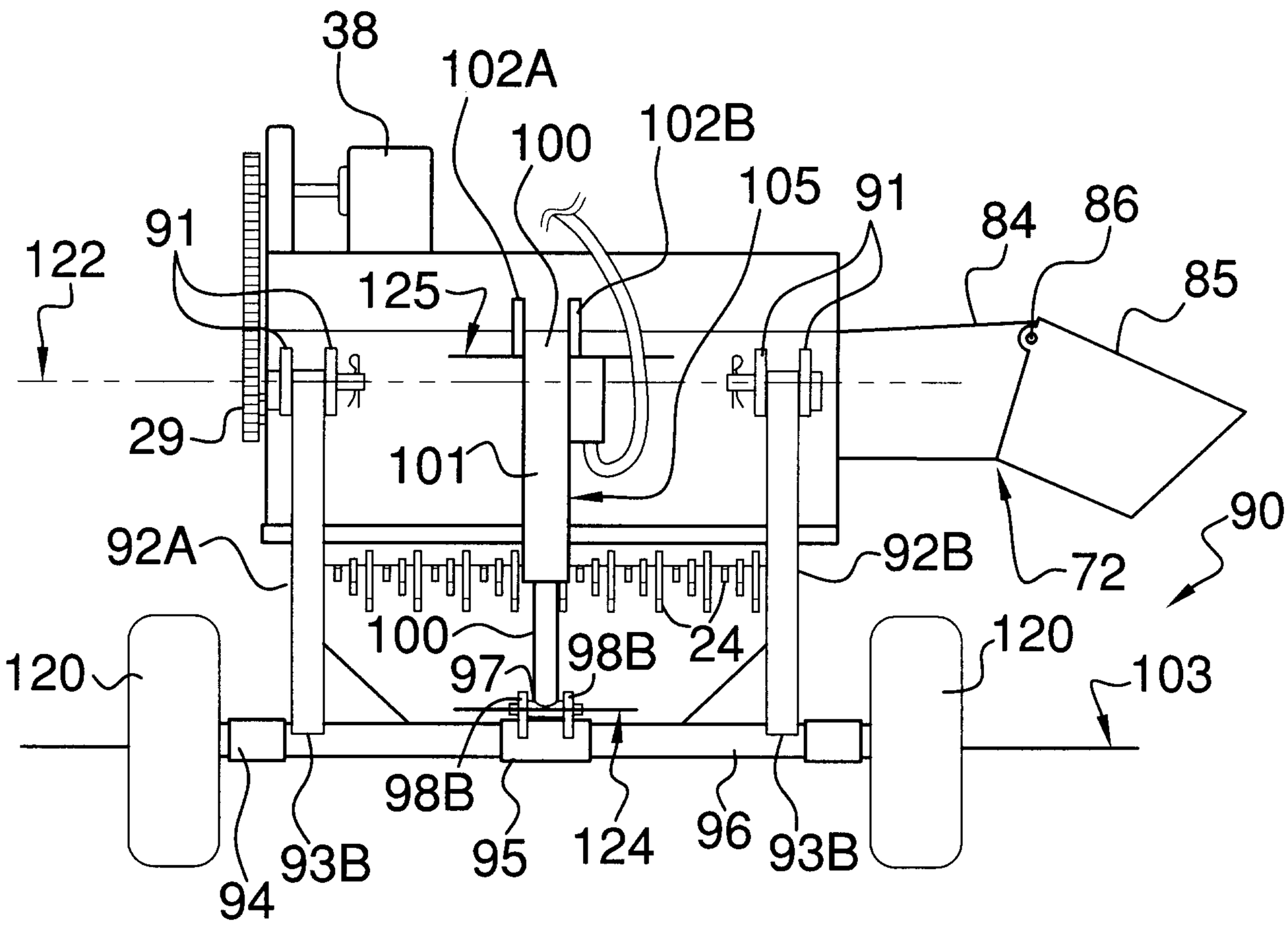
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FIG. 3

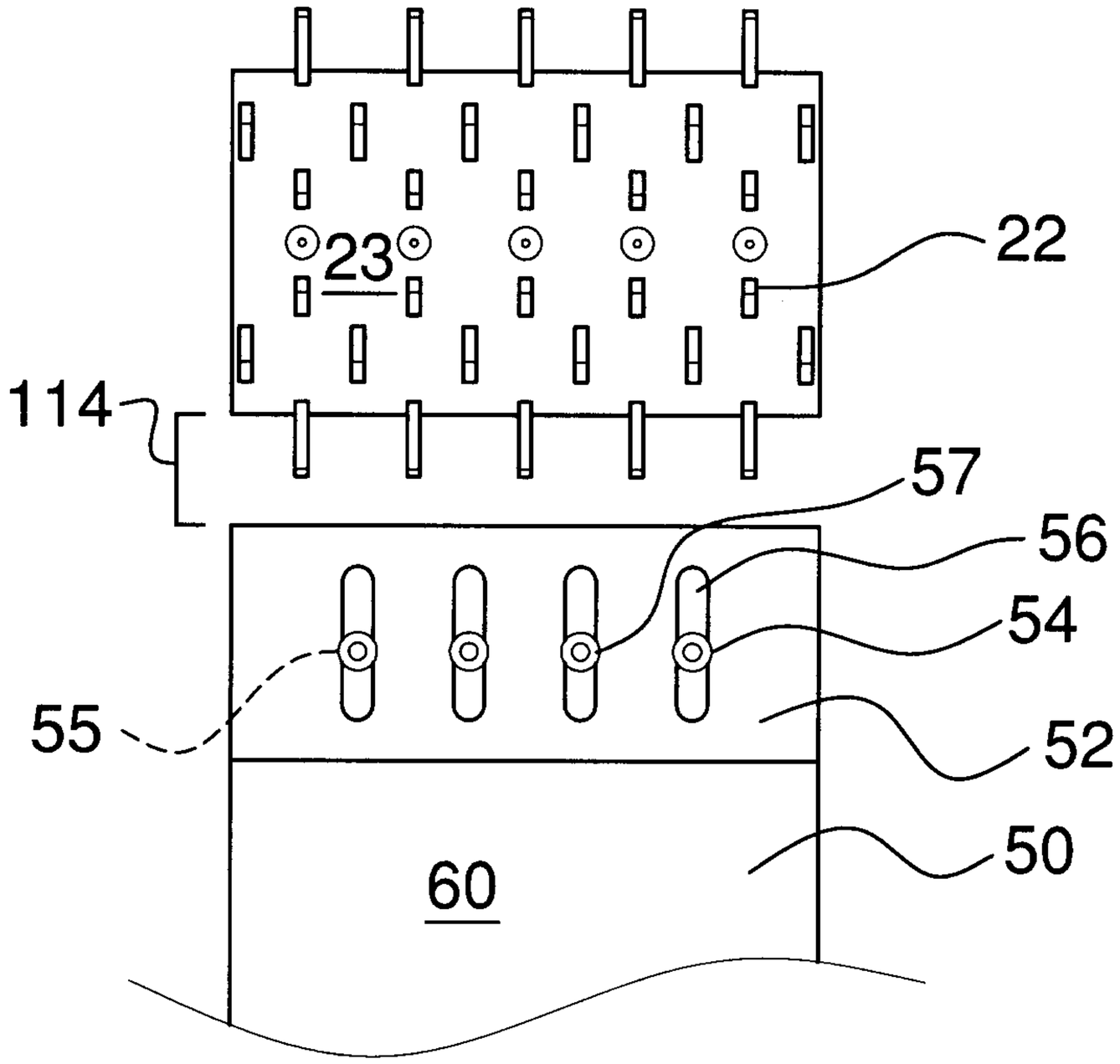


FIG. 4

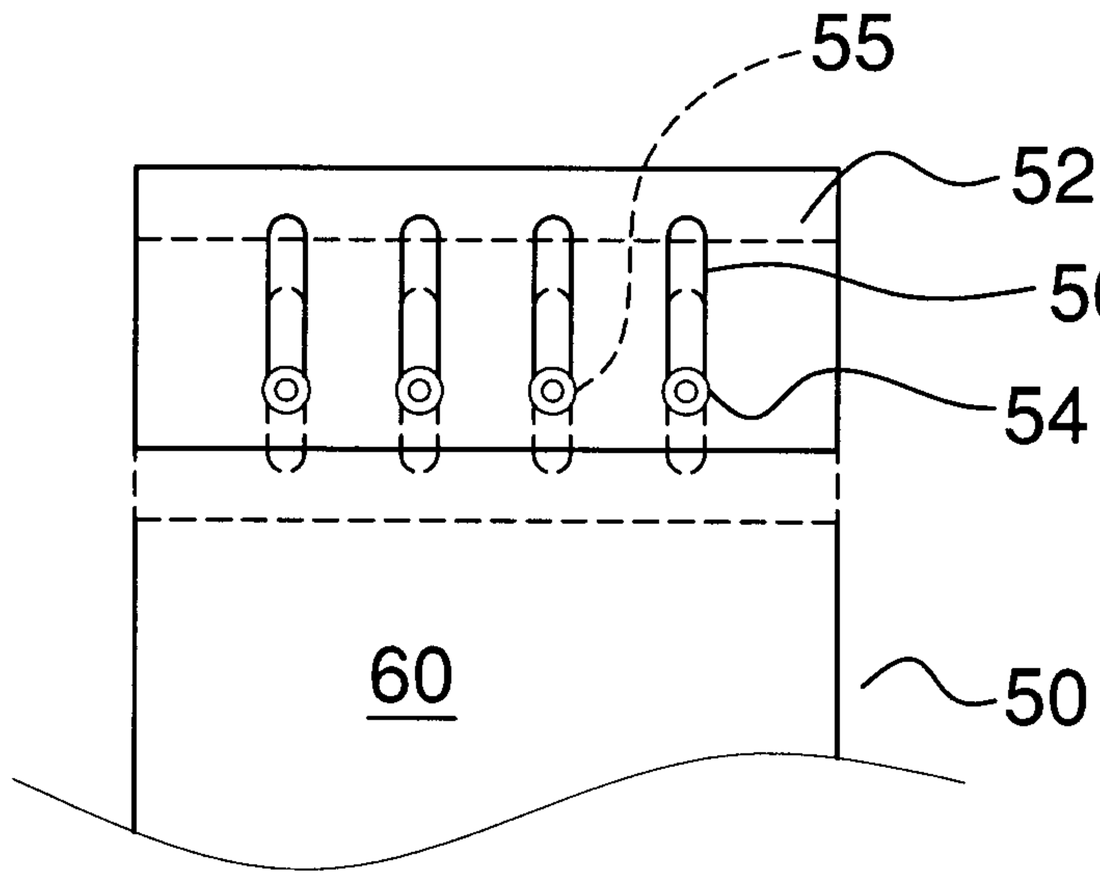


FIG. 5

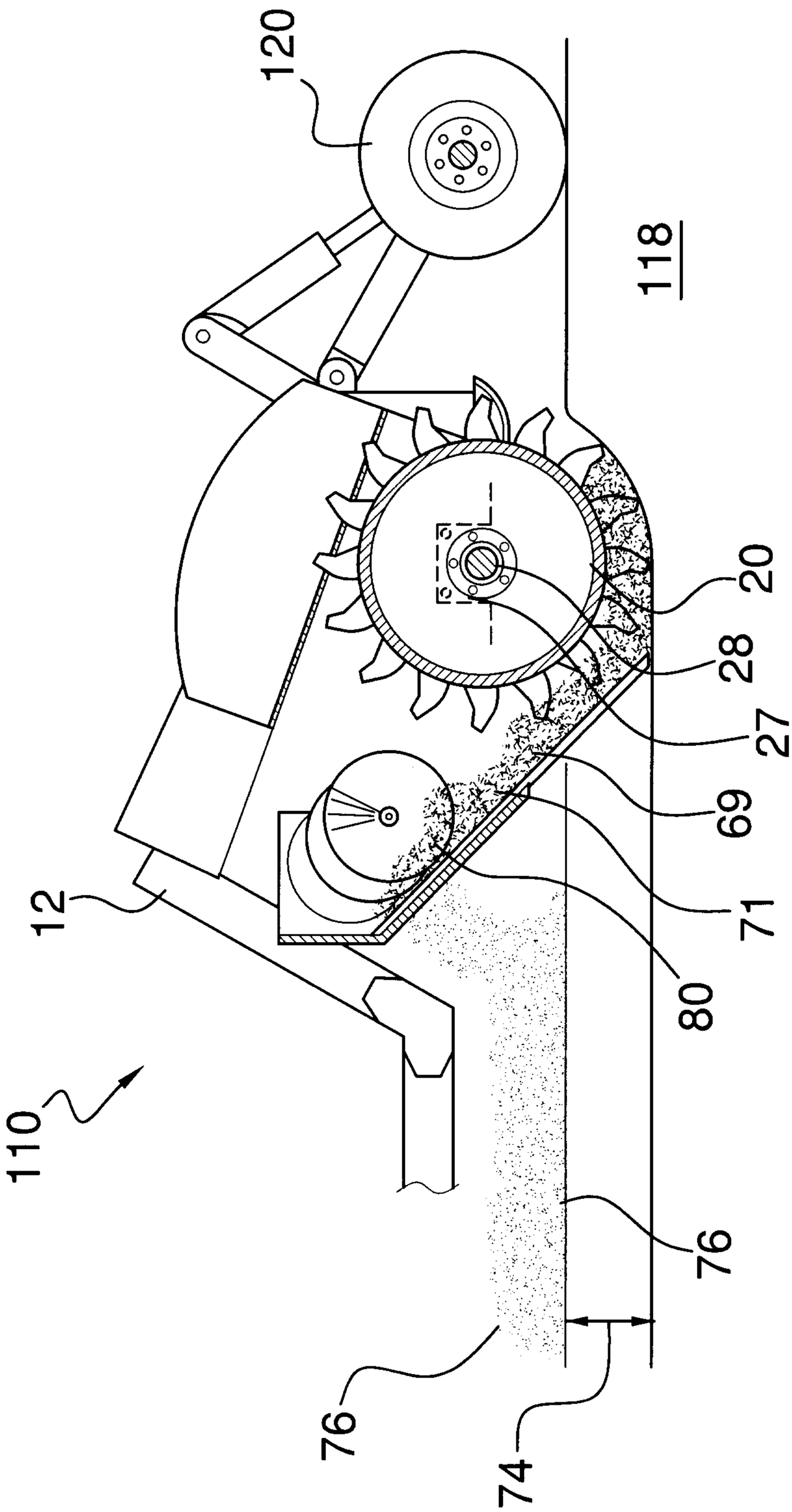
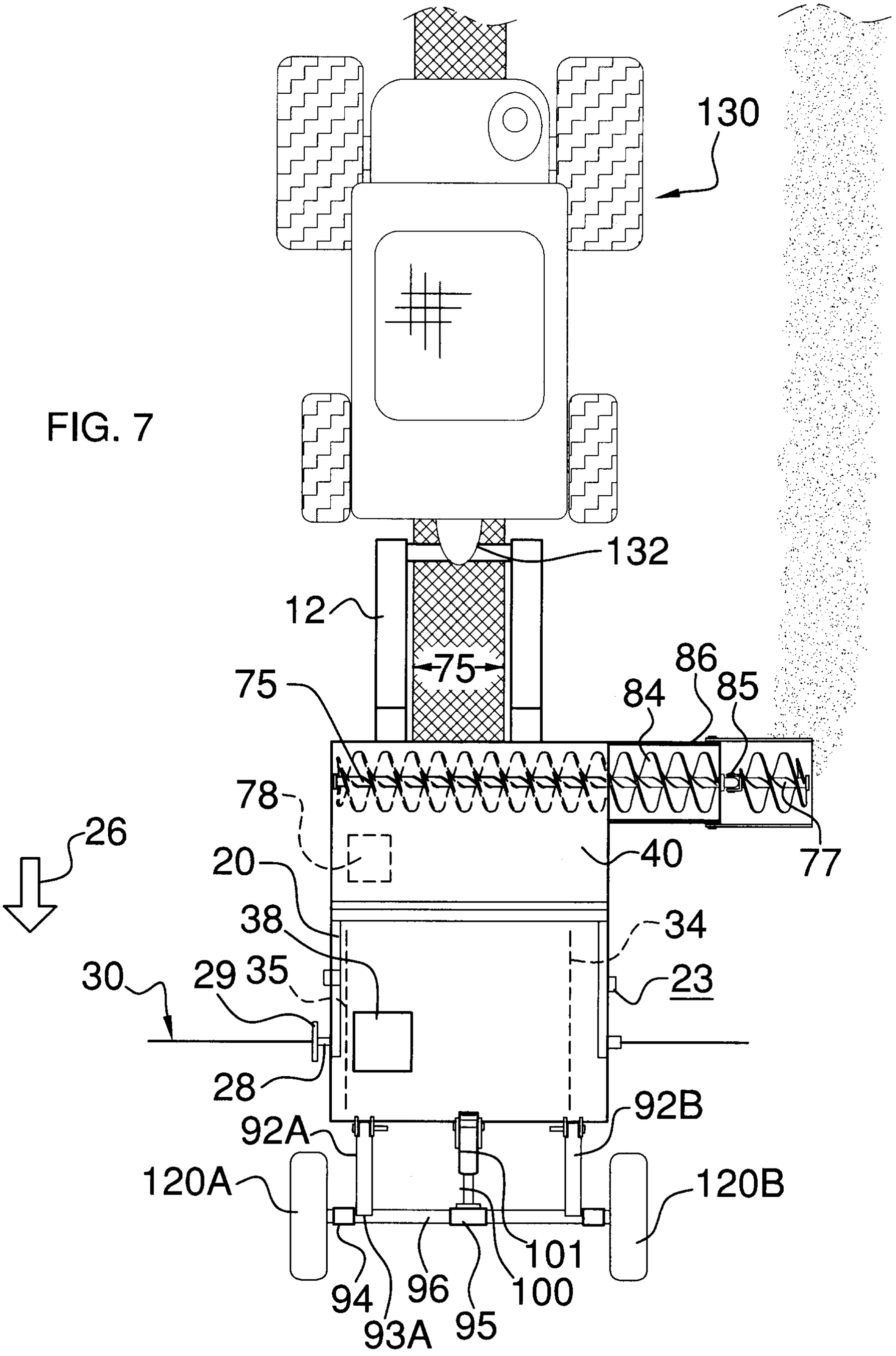


FIG. 6

FIG. 7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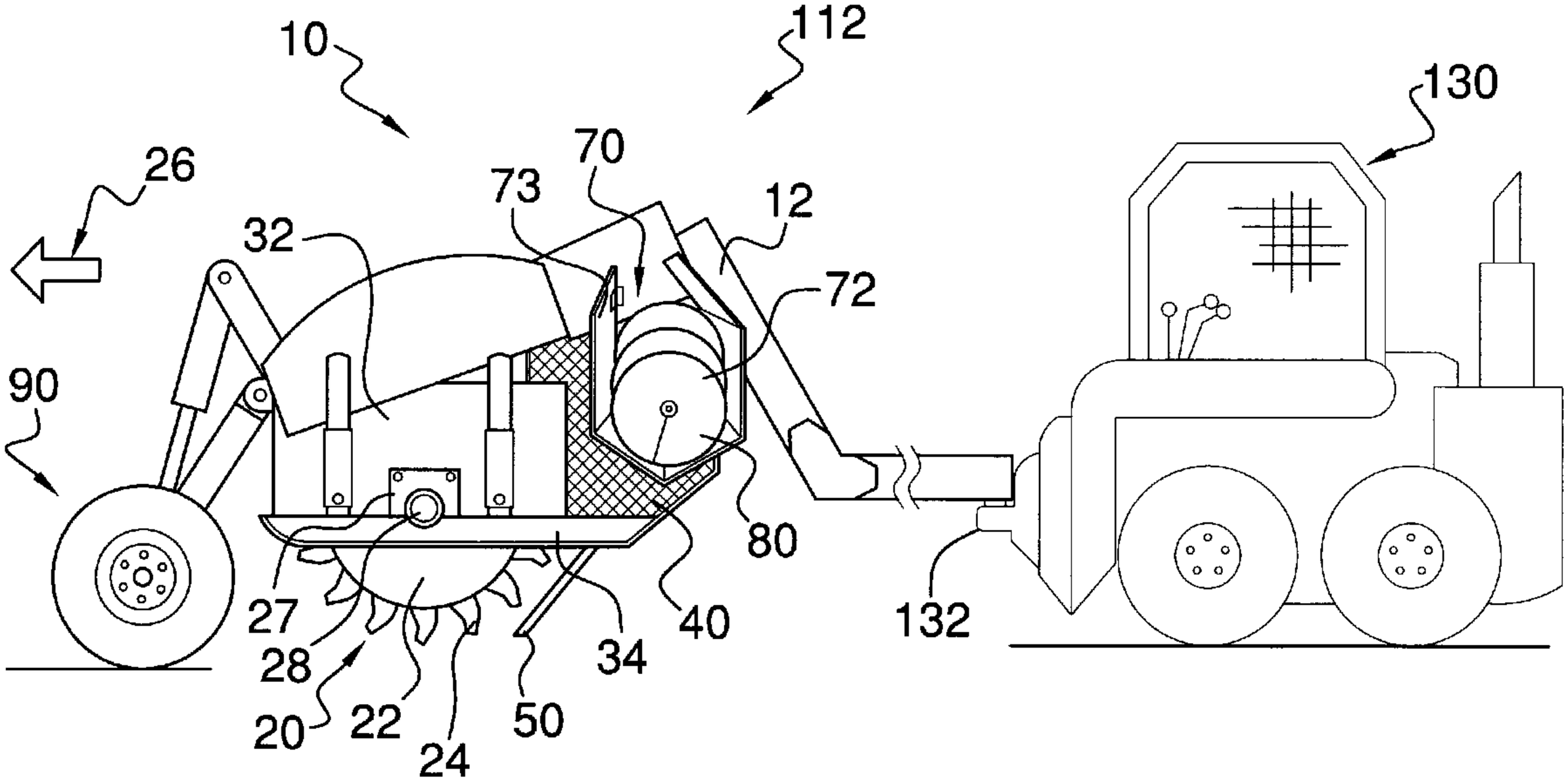
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