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2017276303 14 Dec 2017

ABSTRACT

A vertical cultivation tool including a chassis to allow the tools to be translated across a ground surface to be cultivated, a tyne assembly mounted relative to the chassis and a disc assembly mounted relative to the chassis, the disc assembly including at least one disc with an undulating circumference.

201727630303 14 Dec 2017

A VERTICAL CULTIVATION TOOL

TECHNICAL FIELD

[0001] The present invention relates generally to agricultural or tillage equipment and particularly to a towed tillage apparatus for the mechanical manipulation of soil.

BACKGROUND ART

[0002] Tillage is a mechanical manipulation of soil to provide favourable condition for crop production. Soil tillage consists of breaking the compact surface of earth to a certain depth and to loosen the soil mass, so as to enable the roots of the crops to penetrate and spread into the soil.

[0003] Primary tillage constitutes the initial major soil working operation. It is normally designed to reduce soil strength, cover plant materials and rearrange aggregates. The operations performed to open up any cultivable land with a view to prepare a seed bed for growing crops is known as primary tillage. Animal drawn implements mostly include indigenous plough and mould-board plough. Tractor drawn implements include mould-board plough, disc plough, subsoil plough, chisel plough and other similar implements.

[0004] Tillage operations following primary tillage, those are performed to create proper soil tilth for seeding and planting are secondary tillage. These are lighter and finer operations, performed on the soil after primary tillage operations. Secondary tillage consists of conditioning the soil to meet the different tillage objectives of the farm. The implements include different types of harrow, cultivators, levellers, clod crushers etc.

Types of Tillage

[0005] Minimum Tillage - It is the minimum soil manipulation necessary to meet tillage requirements for crop production.

[0006] Strip Tillage - It is a tillage system in which only isolated bands of soil are tilled.

[0007] Rotary Tillage -It is the tillage operations employing rotary action to cut, break and mix the soil.

[0008] Mulch Tillage -It is the preparations of soil in such a way that plant residues or other mulching materials are specially left on or near the surface.

[0009] Combined Tillage -Operations simultaneously utilizing two or more different types

of tillage tools or implements to simplify, control or reduce the number of operations over a field are called combined tillage.

[0010] It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

SUMMARY OF INVENTION

[0011] The present invention is directed to a vertical cultivation tool, which may at least partially overcome at least one of the abovementioned disadvantages or provide the consumer with a useful or commercial choice.

[0011a] In an aspect, the present invention provides a vertical cultivation tool, including: a chassis to allow the tool to be translated across a ground surface to be cultivated; a tyne assembly mounted relative to the chassis; and a disc assembly removably mounted relative to the chassis, the disc assembly including at least one disc mounted on at least one elongate shaft, said at least one disc having an undulating circumference; wherein the disc assembly further includes at least a pair of elongate mounting arms mounted relative to said at least one elongate shaft, said at least a pair of elongate mounting arms mounted relative to a primary clamp member, said primary clamp member arranged substantially parallel to said at least one elongate shaft, and wherein said primary clamp member is removably mounted to said chassis.

[0012] Also disclosed herein is a vertical cultivation tool including a chassis to allow the tool to be translated across a ground surface to be cultivated, a tyne assembly mounted relative to the chassis and a disc assembly mounted relative to the chassis, the disc assembly including at least one disc with an undulating circumference.

[0013] The movement of a tine or disc dragged horizontally through the soil mixes the soil layers and/or displaces soil laterally. In contrast, the principle of the present invention is "vertical cultivation" directed at producing soil movement in a substantially vertical plane only and otherwise minimising soil disturbance. Vertical cultivation produces minimum soil disturbance with maximum shattering for increased root growth. The tyne assembly used in the present invention will typically be configured to aerate the soil whilst minimising soil movement laterally.

[0014] The vertical cultivation tool of the present invention is preferably adapted to be mounted relative to a machine for example a tractor or similar in order to be drawn behind the tractor. Alternatively, the vertical cultivation tool may be integrated into a self-propelled machine.

[0015] The vertical cultivation tool of the present invention includes a chassis. The chassis may be of any type but will normally be or include a frame structure in order to allow the Tyne assembly and disc assembly to be mounted relative to the chassis and to allow the chassis to be mounted relative to a machine.

[0016] In a preferred embodiment, the chassis of the present invention will be manufactured

2017276303 14 Dec 2017

from a number of members which are located relative to one another and preferably attached, permanently to one another. Normally, the members of the chassis will located in the same plane.

[0017] Typically, the chassis of the preferred embodiment is substantially rectangular when viewed in plan. The chassis of the preferred embodiment will be manufactured from a pair of end members and at least a pair of spaced apart transverse members are attached, preferably directly to each of the pair of end members to define a substantially rectangular outer frame. One or more support members may be provided across the width of the frame, typically extending generally parallel to each of the end members. In a particularly preferred embodiment, a pair of spaced apart support members are preferably provided substantially centrally across the width of the chassis in order to allow a mounting assembly to be provided approximately centrally in order to mount the cultivation tool relative to the machine.

[0018] One or more angle bracing members may be provided.

[0019] One or more sheet members or similar may be provided, preferably between the end members and the support member on each lateral side of the chassis and also between the spaced apart transverse members. Provision of sheet members in this particular region will preferably prevent any soil thrown upwardly during cultivation from passing the upper regions of the chassis.

[0020] The chassis members will typically be manufactured of a robust material such as metal and the attachment of the members relative to one another will normally be achieved by a robust attachment method such as welding for example although other types of attachment may be used such as providing bolts or other types of fasteners.

[0021] The tyne assembly will preferably be located relative to the chassis and normally, substantially permanently attached to the chassis. In a particularly preferred embodiment, a pair of tyne assemblies is preferably provided, one on either lateral side of the midline of the tool. Each of the tyne assemblies will preferably have a substantially unitary shaft and the shaft of each of the tyne assemblies will normally be mounted to one or more members of the chassis. In particular, each of the shaft will preferably be mounted using at least a pair of elongate mounting arms preferably with one mounting arm provided at either end of the shaft. An upper portion of the mounting arm will typically be mounted relative to and preferably directly to either the end member of the chassis or an intermediate support arm of the chassis.

[0022] The disc assembly is also mounted relative to the chassis but is preferably mounted

2017276303 14 Dec 2017

to allow it to be movable relative to the chassis and/or be removable attachment relative to the chassis. The disc assembly preferably includes at least one elongate shaft mounted relative to at least a pair of elongate mounting arms which are attached, preferably directly to one or more chassis members. In a particularly preferred embodiment, three mounting arms are provided spaced over the width of the chassis in order to support a substantially unitary shaft of the disc assembly. It is further preferred that the elongate mounting arms used to attach the disc assembly to the chassis preferably angle rearwardly as they extend downwardly away from the chassis.

[0023] The elongate mounting arms are preferably mounted to or relative to the chassis or one or more chassis frame members. In a particularly preferred configuration, the elongate mounting arms are preferably mounted relative to a primary clamp member used to attach the disc assembly relative to the chassis. Preferably, the disc assembly will be mounted relative to the rearward transverse chassis frame member.

[0024] The primary clamp member is preferably elongate and is preferably located substantially parallel to the shaft of the disc assembly. A portion of the primary clamp member preferably abuts a portion of the rear transverse chassis member when the disc assembly is attached to the chassis. Although more than one primary clamp member may be used, it is preferred that a single primary clamp member is provided. Preferably, the outermost mounting arms of the disc assembly are provided extending substantially transversely to the outer ends of the primary clamp member.

[0025] One or more secondary clamp members are also preferably provided and preferably in association with the at least one primary clamp member. Normally more than one secondary clamp member is provided, spaced over the width of the disc assembly. Each secondary clamp member is preferably spaced from the primary clamp member defining a gap which accommodates the rear transverse chassis member. One or more fasteners are preferably provided in order to allow the primary and secondary clamp members to clamp about the rear transverse chassis member. The fasteners will preferably clamp on a forward side and rearward side of the chassis member and/or through the chassis member. A forward fastener and a rearward fastener will generally be provided on each of the secondary clamp members. The secondary clamp members may be attached to the primary clamp member or may be separable therefrom and then attachable relative thereto using the fasteners when the disc assembly is to be attached relative to the chassis.

[0026] The tool of the present invention may include one or more support legs which are provided relative to the chassis in order to be moved relative to the chassis to support the chassis

2017276303 14 Dec 2017

with the tyne assembly and disc assembly above the ground surface when the tool is not in use. Preferably, four support legs are provided, one at each corner of the preferred substantially rectangular chassis. In a particularly preferred embodiment, a mounting sleeve is preferably provided at each corner of the chassis and the support legs are preferably mounted relative to the sleeve and movable within the sleeve between an extended position which is used when the tool is not in use, and a retracted, use position in which the support legs are moved above the axis of the shafts of the tyne assembly and a assembly. In some embodiments, the support legs can be removed entirely but normally, the support legs will simply be moved to the retracted position in order that they are available if an operator wishes to remove the tool from the machine drawing the tool. It is preferred that a threaded assembly is provided substantially transversely relative to the sleeve in order to allow the temporary fixing of the position of the support leg relative to the sleeve as required.

[0027] One or more tyne assemblies may be provided. Preferably, a pair of tyne assemblies are provided, one on either lateral side of the chassis. The or each tyne assembly will preferably include an elongate shaft with a number of tyne sets extending substantially radially therefrom. A number of tyne sets are preferably spaced over the length of each shaft. The preferred pair of tyne assemblies will typically be provided with the shaft at an angle to the direction of travel. Preferably, the angle will be approximately 10° rearwardly in the direction of travel. In other words, an inner end of the shaft is typically located forwardly of the rearward end of the shaft in the direction of travel. The tyne sets are typically provided substantially perpendicularly to the shaft and therefore, at an angle to the direction of travel. The tyne sets are also typically offset radially from one another and preferably in an alternating offset pattern.

[0028] Each of the Tyne sets preferably include at least one arcuate collar portion with more than one elongate aerating tyne extending from an outer edge of the collar portion.

[0029] The at least partially arcuate collar portion will typically be at least partially circular. In particular, the collar portion will typically be confiured as a part of an annular or circular collar, with multiple tyne assemblies being used to form a complete annulus or circular formation for attachment about a shaft of the agricultural implement.

[0030] In a most preferred form, the collar portion will be approximately semi-circular.

[0031] The collar portion will normally be provided with one or more openings therethrough to facilitate use of fastening means to attach the assembly relative to the shaft of the agricultural implement. Normally, a fixed plate is attached to the shaft and the assembly is attached to the

2017276303 14 Dec 2017

plate using a plurality of bolts or similar.

[0032] The ground cutting members or tynes will normally be integrally formed with the collar portion and radiate therefrom.

[0033] The ground cutting members or tynes, are typically formed from planar material such as steel plate and when viewed in side elevation, the outermost part thereof is narrower than the root thereof. The outermost part of each of the ground cutting members is formed to a tip, which may have any configuration such as pointed or bevelled or angled.

[0034] Each of the ground cutting members is constructed and arranged so that when mounted on the shafts and viewed along the axes of the shafts the outermost part of each of the members is narrower than the root thereof.

[0035] During the initial insertion of the ground cutting member into the ground the sharpened edge which contacts the ground surface first constitutes the leading edge. However when the sharpened edge has penetrated the ground and the ground cutting member is projecting substantially vertically downward from the shafts, the opposite edge which is typically unsharpened, then becomes the leading edge and remains so until further rotation of the shaft raises the ground cutting member from the soil. It is the engagement of this unsharpened edge with the ground that will typically rotate the assembly about the shaft.

[0036] A portion of the unsharpened edge will typically be removed or scalloped out in order that the unsharpened edge is more easily released from the ground upon rotation of the tyne out of the ground. Normally the scalloped portion is located opposite only a portion of the sharpened edge and the remainder is located towards the root of the tyne, but again, on the edge opposite the sharpened edge.

[0037] To assist initial penetration of the ground cutting member into the ground, one or more edges of each tyne may be bevelled or sharpened. To assist the sharpened edge in its function as leading edge and to prevent the soil being pushed ahead of the ground cutting members as the apparatus is displaced across the ground surface, on or more edges may be partially bevelled from a point intermediate the length thereof to the root thereof.

[0038] Edges of each tyne may converge obliquely to meet other edges, projecting substantially radially from the shaft, at the tip and at the other end meets edge which projects parallel to the edge.

2017276303 14 Dec 2017

[0039] According to the preferred embodiment of the invention, the tynes of each tyne set are preferably spaced equally about the arcuate collar portion. Where three tynes are provided on a semi-circular collar portion, the unsharpened edges of adjacent tynes are typically separated by approximately 60°.

[0040] The root of the tynes is preferably wide enough such that at least a pair of openings in the collar are contained between extension lines of the sharpened and unsharpened edges of the tyne.

[0041] The ground cutting members once formed are preferably case hardened.

[0042] Whichever form of mounting is selected the ground cutting members are preferably mounted on the shafts so that the planes thereof are angled to the axis of the shafts toward the outer ends thereof. While this angle may lie in the range of 70° -90° to the axis of the shaft, the angle is preferably set at 85° to the axis of the shaft. The angle is preferably such that at no time does the angle of the ground cutting member to the axis of the shaft exceed the angle of the shaft to the direction of travel of the apparatus.

[0043] It will be appreciated that by angling the ground cutting members to the shafts the initial penetration thereof into the ground is made easier as the alignment of the blade is closer to the direction of travel. Once in the ground, however, the aerating function is enhanced as the blades are twisted through a greater angle as they pass under the central axis of the shafts.

[0044] The ground cutting members are preferably provided in series of three, the members of each series being equi-spaced about the periphery of the arcuate collar portion. When the tyne assemblies are assembled together, six tynes are therefore provided although this may vary.

[0045] Further series of ground cutting members are preferably spaced along the length of the shafts, and each series is preferably circumferentially staggered from the adjacent series to ensure complete penetration and aeration of the soil or pastures. In the embodiment each series is circumferentially staggered at 60° from the adjacent series.

[0046] The cutting members may be oriented such that the longitudinal centre line of each cutting member passes through the axis of rotation of the shaft. Alternatively, the cutting members may be oriented such that the longitudinal centre line of each cutting member is shifted rearwardly relative to the direction of movement of the shaft so that the longitudinal centre line of each cutting member is rearwardly spaced from the axis of rotation of the shaft, and also by twisting each cutting member by a small angle about its longitudinal centre line.

2017276303 14 Dec 2017

[0047] One or more disc assemblies may be provided. It is preferred that a single disc assembly be provided on a single shaft with a number of discs spaced over the length of the shaft or the width of the tool. The preferred shaft is substantially perpendicularly oriented relative to the direction of travel. The disc assembly of the present invention is preferably provided rearwardly of the tyne assembly in the direction of travel.

[0048] The discs located on the shaft of the disc assembly is preferably offset from the tyne sets located on each of the tyne assemblies in order to locate a disc from the disc assembly between adjacent tyne sets on the tyne assembly(ies).

[0049] The discs of the preferred embodiment are preferably generally circular when viewed from the side but may be a shaped polygon such as an octagon for example in order to approximate a circular shape. Each of the discs will typically have an undulating circumference. Preferably, the disc is formed by stamping a planar disk into an undulating shape. The undulations provided will typically be arcuate when viewed in plan. The circumference of the discs has waves, said waves passing in succession from one side of a vertical mid-plane of said disk to the other.

[0050] Normally, a central portion of the disc will be substantially planar in order to allow attachment of the mounting of the disc relative to the shaft. The undulations or waves may be irregular, but will preferably be a regular and repeating about the circumference of the disc. As mentioned, the undulations will preferably be arcuate.

[0051] The circumference of the disc may include at least one notch. Said notch(es) may has (have) the effect of making the disk more aggressive, and therefore of encouraging it to penetrate the ground. Said notch(es) also has (have) a beneficial action on the crumbling of the strip of earth worked.

[0052] The shaft of the preferred disc assembly will normally be substantially coplanar with the shaft(s) of the tyne assembly(ies). The axis of the shaft of the preferred disc assembly will normally be located the same distance from the chassis as the axis of the shaft(s) of the tyne assembly(ies). The discs provided on the disc assembly will normally be smaller in outer diameter than the tyne sets provided on the tyne assembly(ies).

[0053] Normally, at least one and preferably a pair of lifting rams will be provided to adjust the height of each of the tyne assembly(ies) and/or the preferred disc assembly for optimum depth penetration.

2017276303 14 Dec 2017

[0054] The tool of the present invention may be powered or not. In particular, the disc assembly and/or tine assembly may undergo powered rotation or not.

[0055] The tool of the present invention may include a seeding apparatus, preferably a pneumatic of air seeder as the inventor has found that seeding contemporaneously with aeration increases the quality of the pasture, whether in established pastures or in new pastures.

[0056] The preferred seeding apparatus will normally have a number of outlets, preferably linked to a single supply of seeds and each outlet will normally be provided behind the preferred disc assembly in the direction of travel so that the seed is distributed on disturbed soil. This will preferably act to increase seed viability.

[0057] The tool of the present invention may further include a roller assembly located, preferably mounted behind the preferred disc assembly in the direction of travel. The roller will preferably provide a degree of compaction to the disturbed soil. The roller may be weighted to optimise compaction.

[0058] A single roller drum may be provided but in a preferred embodiment, the roller will include a plurality of drums, mounted coaxially with one another. In a particular form, the drums may be wheels with tyres mounted thereto.

[0059] Preferably, the roller assembly is mounted on a pair of arms pivotally mounted relative to the frame of the tool relative to which the tyne assembly(ies) and/or the disc assembly is mounted. Preferably, each of the arms is arcuate to extend over the mounting position for the preferred disc assembly.

[0060] Any of the features described herein can be combined in any combination with any one or more of the other features described herein within the scope of the invention.

[0061] The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge.

BRIEF DESCRIPTION OF DRAWINGS

[0062] Preferred features, embodiments and variations of the invention may be discerned from the following Detailed Description which provides sufficient information for those skilled in the art to perform the invention. The Detailed Description is not to be regarded as limiting the scope of the preceding Summary of the Invention in any way. The Detailed Description will

2017276303 14 Dec 2017

make reference to a number of drawings as follows:

[0063] Figure 1 is an isometric view of a vertical cultivation tool according to a preferred embodiment of the present invention.

[0064] Figure 2 is a view from beneath the vertical cultivation tool illustrated in Figure 1.

[0065] Figure 3 is an end view from the left of the vertical cultivation tool illustrated in Figure 1.

[0066] Figure 4 is an isometric view from the rear of the vertical cultivation tool illustrated in Figure 1.

[0067] Figure 5 is a rear elevation view of the vertical cultivation tool illustrated in Figure 1.

[0068] Figure 6 is an end view from the right of the vertical cultivation tool illustrated in Figure 1.

[0069] Figure 7 is an isometric view from the front of the vertical cultivation tool illustrated in Figure 1.

[0070] Figure 8 is an isometric view from the front of a vertical cultivation tool with seed spreader according to a preferred embodiment of the present invention.

[0071] Figure 9 is a detailed view from the front of the configuration illustrated in Figure 8.

[0072] Figure 10 is a view from the rear of the configuration illustrated in Figure 8.

[0073] Figure 11 is a detailed view from above the rear of the configuration illustrated in Figure 8.

[0074] Figure 12 is a view from the front of the configuration illustrated in Figure 8.

[0075] Figure 13 is a view from the side of the configuration illustrated in Figure 8.

[0076] Figure 14 is a schematic side view of an alternative configuration of a vertical cultivation tool according to a preferred embodiment of the present invention.

DESCRIPTION OF EMBODIMENTS

[0077] According to a particularly preferred embodiment of the present invention, a vertical cultivation tool 10 is provided.

2017276303 14 Dec 2017

[0078] The vertical cultivation tool 10 illustrated in the accompanying Figures includes a chassis 11 to allow the tool to be translated across a ground surface to be cultivated, a tyne assembly 12 mounted relative to the chassis 11 and a disc assembly 13 mounted relative to the chassis 11, the disc assembly 13 including at least one disc 14 with an undulating circumference.

[0079] The vertical cultivation tool 10 is preferably adapted to be mounted relative to a machine for example a tractor or similar in order to be drawn behind the tractor. Alternatively, the vertical cultivation tool may be integrated into a self-propelled machine.

[0080] The chassis 11 may be of any type but will normally be or include a frame structure in order to allow the tyne assembly 12 and disc assembly 13 to be mounted relative to the chassis 11 and to allow the chassis 11 to be mounted relative to a machine.

[0081] In the preferred embodiment illustrated, the chassis 11 is manufactured from a number of members which are located relative to one another and attached, permanently to one another. Normally, the members of the chassis will located in the same plane.

[0082] As illustrated, the chassis 11 is substantially rectangular when viewed in plan, manufactured from a pair of end members 15 and a pair of spaced apart transverse members (a forward transverse member 16 and a rear transverse member 17) attached directly to each of the pair of end members 15 to define a substantially rectangular outer frame. A pair of spaced apart support members 18 are preferably provided substantially centrally across the width of the chassis extending generally parallel to each of the end members in order to allow a mounting assembly to be provided approximately centrally in order to mount the cultivation tool relative to the machine.

[0083] A pair of sheet members 19 are provided between the end members 15 and the support member 18, on each lateral side of the chassis and also between the spaced apart transverse members 16, 17. Provision of sheet members 19 in this particular region will preferably prevent any soil thrown upwardly during cultivation from passing the upper regions of the chassis.

[0084] The chassis members of the preferred embodiment are manufactured of a robust material such as metal and the attachment of the members relative to one another will normally be achieved by a robust attachment method such as welding for example although other types of attachment may be used such as providing bolts or other types of fasteners.

[0085] The tyne assembly 12 of the illustrated embodiment is permanently attached to the

2017276303 14 Dec 2017

chassis. In the preferred embodiment illustrated, a pair of tyne assemblies 12 is provided, one on either lateral side of the midline of the tool 10, best illustrated in Figure 2. Each of the tyne assemblies 12 has a substantially unitary shaft 20 and the shaft 20 of each of the tyne assemblies 12 is mounted to one or more members of the chassis. In particular, each of the shafts 20 is mounted using a pair of elongate mounting arms 21 with one mounting arm 21 provided at either end of the shaft 20. An upper portion of the mounting arm is mounted relative directly to the end member 15 of the chassis 11 or an intermediate support arm 18 of the chassis.

[0086] The disc assembly 13 is also mounted relative to the chassis 11 but is preferably mounted to allow its removable attachment relative to the chassis 11. The disc assembly 13 includes at an elongate shaft 22 mounted relative to three mounting arms 23 spaced over the width of the chassis 11 in order to support the shaft 22 of the disc assembly 13. It is further preferred that the elongate mounting arms 23 used to attach the disc assembly 13 to the chassis are angled rearwardly as they extend downwardly away from the chassis as illustrated in Figure 3.

[0087] The elongate mounting arms 23 are mounted to one or more chassis frame members. In the particularly preferred configuration, the elongate mounting arms 23 of the disc assembly 13 are mounted relative to a primary clamp member 24 used to attach the disc assembly 13 relative to the chassis 11. Preferably, the disc assembly 13 will be mounted relative to the rearward transverse chassis frame member 17 as shown in Figures 1 and 2.

[0088] The primary clamp member 24 is preferably elongate and located substantially parallel to the shaft 22 of the disc assembly 13. When the disc assembly is attached to the tool, a portion of the primary clamp member 24 abuts a portion of the rear transverse chassis member 17. Although more than one primary clamp member may be used, it is preferred that a single primary clamp member 24 is provided as illustrated. Preferably, the outermost mounting arms 23 of the disc assembly 13 are provided extending substantially transversely to the outer ends of the primary clamp member 24.

[0089] A number of secondary clamp members 25are also provided in association with the primary clamp member 24. Each secondary clamp member 25 is spaced from the primary clamp member 24 defining a gap which accommodates the rear transverse chassis member 17. Fasteners are provided in order to allow the primary clamp member 24 and secondary clamp members 25 to clamp about the rear transverse chassis member 17. The fasteners will preferably clamp on a forward side and rearward side of the rear transverse chassis member 17 and/or through the chassis member. The secondary clamp members 25 are provide separately from the

2017276303 14 Dec 2017

primary clamp member 24 and are attachable relative thereto using the fasteners when the disc assembly 13 is to be attached relative to the chassis. The secondary clamp members of the illustrated embodiment are each a planar plate.

[0090] The tool 10 also include support legs 26 which are provided relative to the chassis in order to be moved relative to the chassis to support the chassis with the tyne assembly 12 and disc assembly 13 attached, above the ground surface when the tool 10 is not in use. Preferably, four support arms 27 are provided, one at each corner of the substantially rectangular chassis. In a particularly preferred embodiment, a mounting sleeve 27 is provided at each corner of the chassis 11 and the support legs 26 are mounted relative to a respective sleeve 27 and movable within the sleeve 27 between an extended position which is used when the tool is not in use, and a retracted, use position in which the support leg 27 is moved above the axis of the shafts of the tyne assembly and disc assembly. It is preferred that a threaded assembly is provided substantially transversely relative to the sleeve in order to allow the temporary fixing of the position of the support leg relative to the sleeve as required.

[0091] Each tyne assembly 12 includes an elongate shaft 20 with a number of tyne sets 28 extending substantially radially therefrom. The tyne sets are spaced over the length of each shaft 20. The pair of tyne assemblies is provided with the shaft 20 at an angle to the direction of travel (indicated by the arrow in Figures 1 and 2). The angle preferred is approximately 10° rearwardly in the direction of travel. In other words, an inner end of the shaft 20 is typically located forwardly of the rearward end of the shaft 20 in the direction of travel. The tyne sets 28 are provided substantially perpendicularly to the shaft 20 and therefore, at an angle to the direction of travel. The tyne sets 28 are also typically offset radially from one another and preferably in an alternating offset pattern.

[0092] Each of the tyne sets 28 preferably includes at least one arcuate collar portion with more than one elongate aerating tyne extending from an outer edge of the collar portion.

[0093] The at least partially arcuate collar portion will typically be at least partially circular. In particular, the collar portion will typically be confiured as a part of an annular or circular collar, with multiple tyne assemblies being used to form a complete annulus or circular formation for attachment about a shaft of the agricultural implement.

[0094] In a most preferred form, the collar portion will be approximately semi-circular.

[0095] The collar portion will normally be provided with one or more openings therethrough to facilitate use of fastening means to attach the assembly relative to the shaft of the agricultural

2017276303 14 Dec 2017

implement. Normally, a fixed plate is attached to the shaft and the assembly is attached to the plate using a plurality of bolts or similar.

[0096] The ground cutting members or tynes will normally be integrally formed with the collar portion and radiate therefrom.

[0097] The ground cutting members or tynes, are typically formed from planar material such as steel plate and when viewed in side elevation, the outermost part thereof is narrower than the root thereof. The outermost part of each of the ground cutting members is formed to a tip, which may have any configuration such as pointed or bevelled or angled.

[0098] Each of the ground cutting members is constructed and arranged so that when mounted on the shafts and viewed along the axes of the shafts the outermost part of each of the members is narrower than the root thereof.

[0099] During the initial insertion of the ground cutting member into the ground the sharpened edge which contacts the ground surface first constitutes the leading edge. However when the sharpened edge has penetrated the ground and the ground cutting member is projecting substantially vertically downward from the shafts, the opposite edge which is typically unsharpened, then becomes the leading edge and remains so until further rotation of the shaft raises the ground cutting member from the soil. It is the engagement of this unsharpened edge with the ground that will typically rotate the assembly about the shaft.

[0100] A portion of the unsharpened edge will typically be removed or scalloped out in order that the unsharpened edge is more easily released from the ground upon rotation of the tyne out of the ground. Normally the scalloped portion is located opposite only a portion of the sharpened edge and the remainder is located towards the root of the tyne, but again, on the edge opposite the sharpened edge.

[0101] To assist initial penetration of the ground cutting member into the ground, one or more edges of each tyne may be bevelled or sharpened. To assist the sharpened edge in its function as leading edge and to prevent the soil being pushed ahead of the ground cutting members as the apparatus is displaced across the ground surface, on or more edges may be partially bevelled from a point intermediate the length thereof to the root thereof.

[0102] It is preferred that a single disc assembly 13 is provided on a single shaft 22 with a number of discs 14 spaced over the length of the shaft 22 or the width of the tool 10. The preferred shaft 22 is substantially perpendicularly oriented relative to the direction of travel. The

2017276303 14 Dec 2017

disc assembly 13 is preferably provided rearwardly of the tyne assembly 12 in the direction of travel as illustrated.

[0103] The discs 14 located on the shaft 22 are preferably offset from the tyne sets 28 located on each of the tyne assemblies 12 in order to locate a disc 14 from the disc assembly 13 between adjacent tyne sets 28 on the tyne assembly(ies) 12 as shown in Figure 2 in particular.

[0104] The discs 14 are preferably generally circular when viewed from the side, shaped as an octagon for example in order to approximate a circular shape. Each of the discs 14 has an undulating circumference formed by stamping a planar disk into an undulating shape. The circumference of each of the discs has waves, the waves passing in succession from one side of a vertical mid-plane of said disk to the other.

[0105] Normally, a central portion of the disc will be substantially planar in order to allow attachment of the mounting of the disc relative to the shaft. The undulations or waves may be irregular, but will preferably be a regular and repeating about the circumference of the disc with the undulations being arcuate.

[0106] The shaft 22 of the preferred disc assembly 13 is substantially coplanar with the shafts 20 of the tyne assemblies 12 as shown in Figure 3. The axis of the shaft 22 of the disc assembly will normally be located the same distance from the chassis as the axis of the shafts 20 of the tyne assemblies 12. The discs 14 provided on the disc assembly will normally be smaller in outer diameter than the tyne sets 28 provided on the tyne assemblies.

[0107] As illustrated in Figures 8 to 13, the tool 10 may include a seeding apparatus, preferably a pneumatic or air seeder including a seed storage hopper 29 associated with a pneumatic conveying system to provide each of a number of seeder pipes 30 with seed from the hopper for distribution on the disturbed ground surface..

[0108] The seeder pipes 30 each has an outlet provided behind the disc assembly in the direction of travel so that the seed is distributed on disturbed soil. This will preferably act to increase seed viability.

[0109] The tool 10 may further include a roller 31 located, mounted behind the disc assembly 13 in the direction of travel. The roller 31 will preferably provide a degree of compaction to the disturbed soil. The roller 31 may be weighted to optimise compaction.

[0110] In the illustrated preferred embodiment, the roller 31 includes a plurality of wheels

2017276303 14 Dec 2017

with tyres mounted thereto.

[0111] Preferably, the roller 31 is mounted on a pair of arms 32 pivotally mounted relative to the frame 33 of the tool 10 relative to which the tyne assembly 12 and the disc assembly 13 is mounted. Preferably, each of the arms 32 is arcuate to extend over the mounting position for the disc assembly 13.

[0112] Figure 13 shows an alternative construction of the tool with the disc assembly 13 being mounted in front (rather than behind) the aerating tyne assembly 12 relative to the frame 33.

[0113] In the present specification and claims (if any), the word 'comprising' and its derivatives including 'comprises' and 'comprise' include each of the stated integers but does not exclude the inclusion of one or more further integers.

[0114] Reference throughout this specification to 'one embodiment' or 'an embodiment' means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases 'in one embodiment' or 'in an embodiment' in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more combinations.

CLAIMS

1. A vertical cultivation tool, including:

a chassis to allow the tool to be translated across a ground surface to be cultivated;

a tyne assembly mounted relative to the chassis; and

a disc assembly removably mounted relative to the chassis, the disc assembly including at least one disc mounted on at least one elongate shaft, said at least one disc having an undulating circumference;

wherein the disc assembly further includes at least a pair of elongate mounting arms mounted relative to said at least one elongate shaft, said at least a pair of elongate mounting arms mounted relative to a primary clamp member, said primary clamp member arranged substantially parallel to said at least one elongate shaft, and wherein said primary clamp member is removably mounted to said chassis.

2. A vertical cultivation tool as claimed in claim 1, including a single chassis mounting both the tyne assembly and the disc assembly.

3. A vertical cultivation tool as claimed in claim 2, wherein the chassis is substantially rectangular when viewed in plan with a mounting assembly to be provided approximately centrally in order to mount the cultivation tool relative to a machine.

4. A vertical cultivation tool as claimed in claim 2 or claim 3, wherein one or more sheet members are provided on the chassis to prevent any soil thrown upwardly during cultivation from passing above the chassis.

5. A vertical cultivation tool as claimed in any one of the preceding claims, wherein each tyne assembly includes an elongate shaft with a number of tyne sets extending substantially radially therefrom.

6. A vertical cultivation tool as claimed in claim 5, wherein a pair of tyne assemblies is provided, one on either lateral side of a midline of the tool.

7. A vertical cultivation tool as claimed in claim 6, wherein the tyne assemblies are provided at an angle to a direction of travel with an inner end of each assembly forwardly of an outer end.

8. A vertical cultivation tool as claimed in claim 6 or claim 7, wherein each of the tyne assemblies has a substantially unitary shaft and the shaft of each of the tyne assemblies is mounted to the chassis.

9. A vertical cultivation tool as claimed in claim 8, wherein the tyne sets are provided substantially perpendicularly to the shaft.

10. A vertical cultivation tool as claimed any one of claims 5 to 9, wherein a number of tyne sets are spaced over the length of each shaft.

11. A vertical cultivation tool as claimed in claim 10, wherein the tyne sets are offset radially from one another in an alternating offset pattern.

12. A vertical cultivation tool as claimed any one of claims 5 to 11, wherein each tyne set includes at least one arcuate collar portion with at least one elongate aerating tyne extending from an outer edge of the collar portion.

13. A vertical cultivation tool as claimed in claim 12, including at least a pair of arcuate collar portions, each collar portion with a number of aerating tynes integrally formed with the collar portion and radially extending therefrom.

14. A vertical cultivation tool as claimed in claim 12 or claim 13, wherein an outermost part of each aerating tyne is narrower than a root when viewed in side elevation having a sharpened, entry edge angled relative to the direction of rotation.

15. A vertical cultivation tool as claimed in claim 14, wherein during initial insertion of the tyne into the ground, the sharpened edge which contacts the ground surface first constitutes the entry edge, and when the sharpened edge has penetrated the ground and the tyne is projecting substantially vertically, an opposite edge of the tyne then becomes a leading edge and remains so until further rotation of the tyne raises the tyne from the

soil through engagement of the opposite edge with the ground to rotate the tyne assembly.

16. A vertical cultivation tool as claimed in any one of the preceding claims, wherein a single disc assembly is provided on a single elongate shaft with a number of discs spaced over the shaft.

17. A vertical cultivation tool as claimed in claim 16, wherein the single elongate shaft is substantially perpendicularly oriented relative to the direction of travel.

18. A vertical cultivation tool as claimed in in any one of the preceding claims, wherein the disc assembly is provided rearwardly of the tyne assembly in the direction of travel.

19. A vertical cultivation tool as claimed in claim 16, wherein the discs located on the single elongate shaft of the disc assembly are offset from the tynes of the tyne assembly.

20. A vertical cultivation tool as claimed in any one of the preceding claims, wherein the disc assembly is pivotably mounted relative to the chassis.

21. A vertical cultivation tool as claimed in claim 20, wherein said at least a pair of elongate mounting arms are angled rearwardly as they extend downwardly away from the chassis.

22. A vertical cultivation tool as claimed in claim 20 or claim 21, wherein the disc assembly is adjustable utilising one or more rams to adjust a depth of the disc assembly.

23. A vertical cultivation tool as claimed in any one of the preceding claims, further including one or more support legs which are provided relative to the chassis in order to be moved relative to the chassis to support the chassis with the tyne assembly and disc assembly above the ground surface when the tool is not in use.

24. A tool as claimed in any one of the preceding claims, further including a seeding apparatus.

25. A tool as claimed in claim 24, wherein the seeding apparatus includes a number of outlets, linked to a single supply of seeds and each outlet is provided behind the tyne assembly in the direction of travel.

26. A tool as claimed in any one of the preceding claims, further including a roller assembly mounted behind the tyne assembly in the direction of travel.

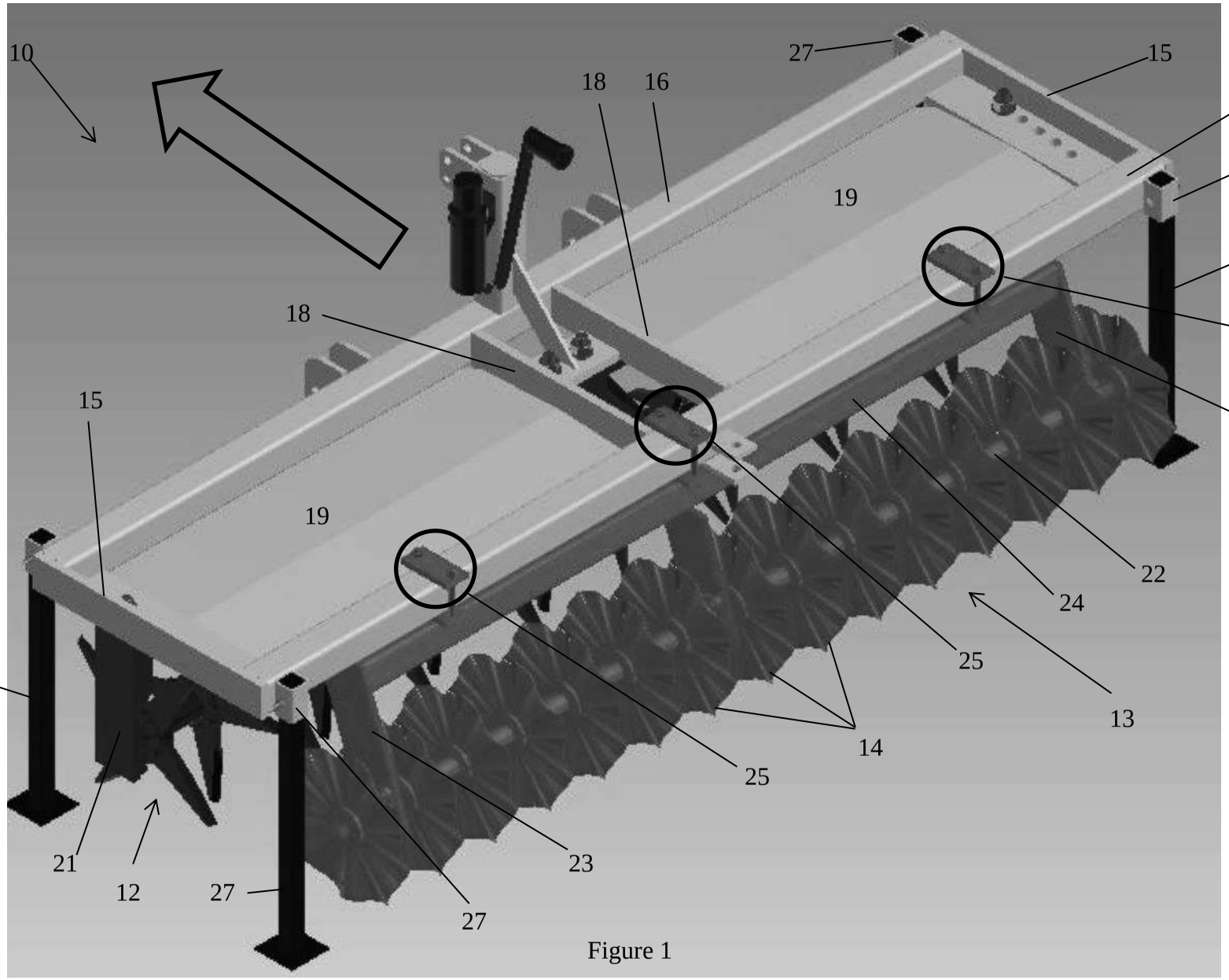
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Figure 1

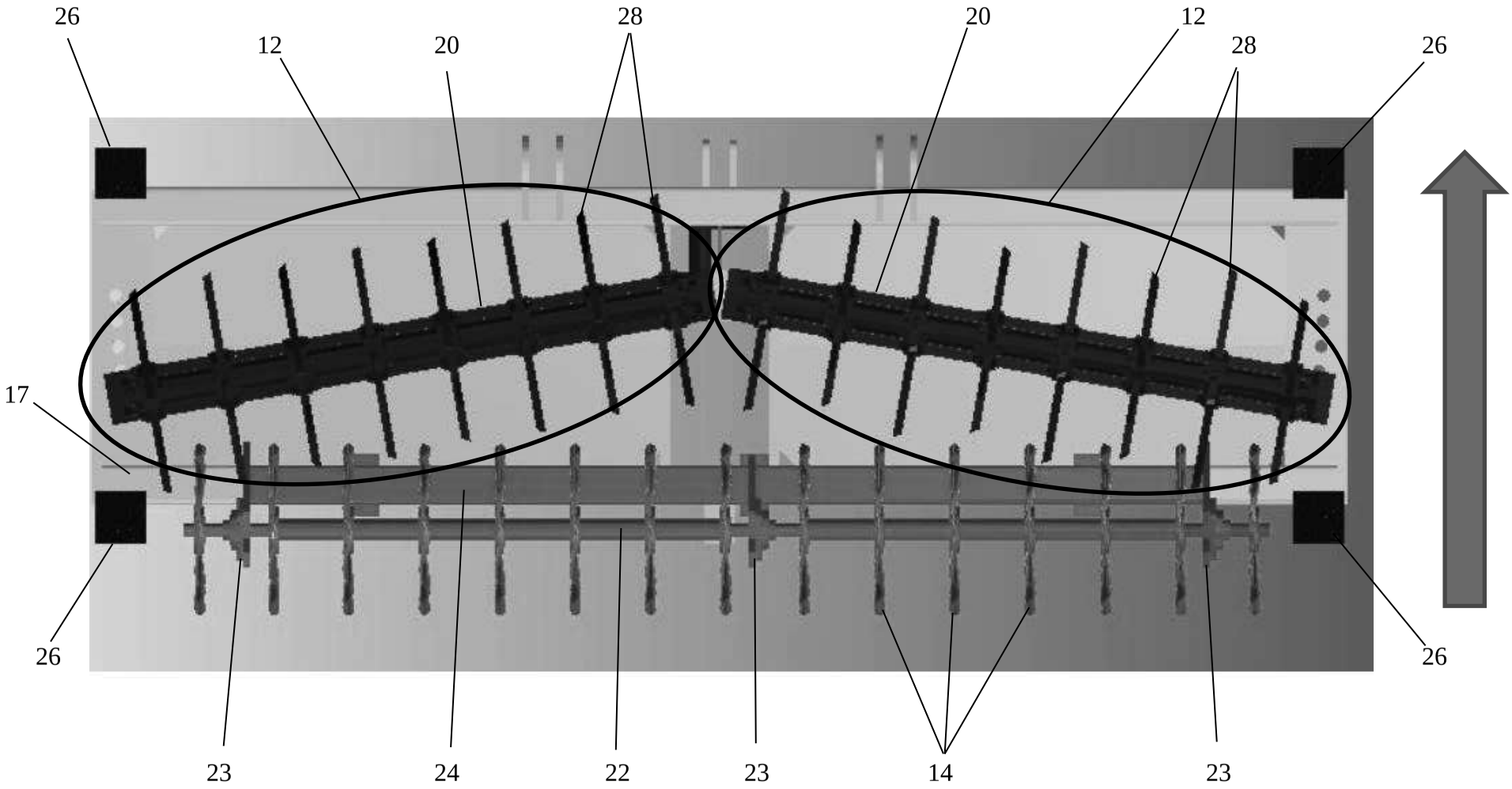

Figure 2

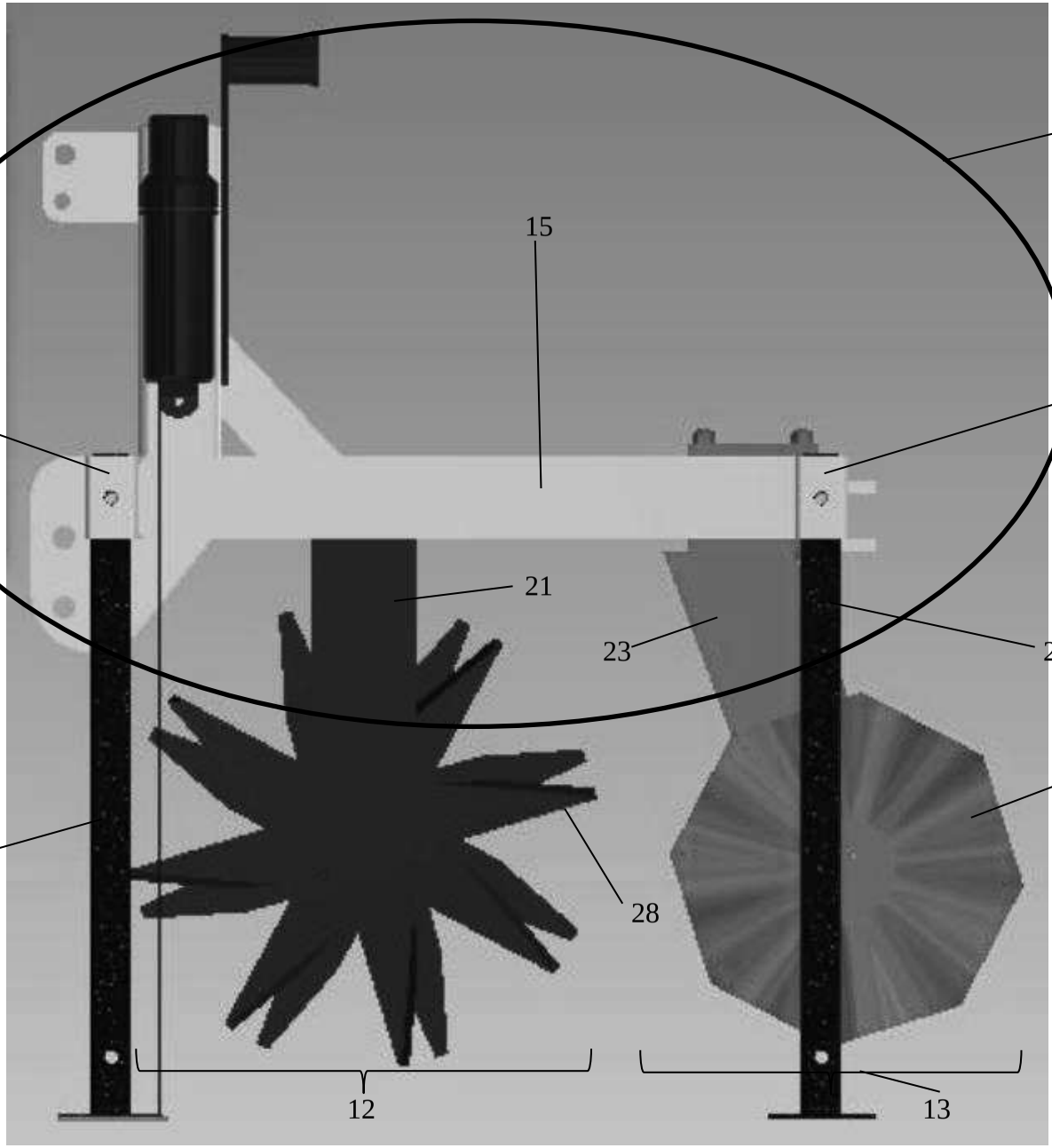

Figure 3

2017276303 14 Dec 2017

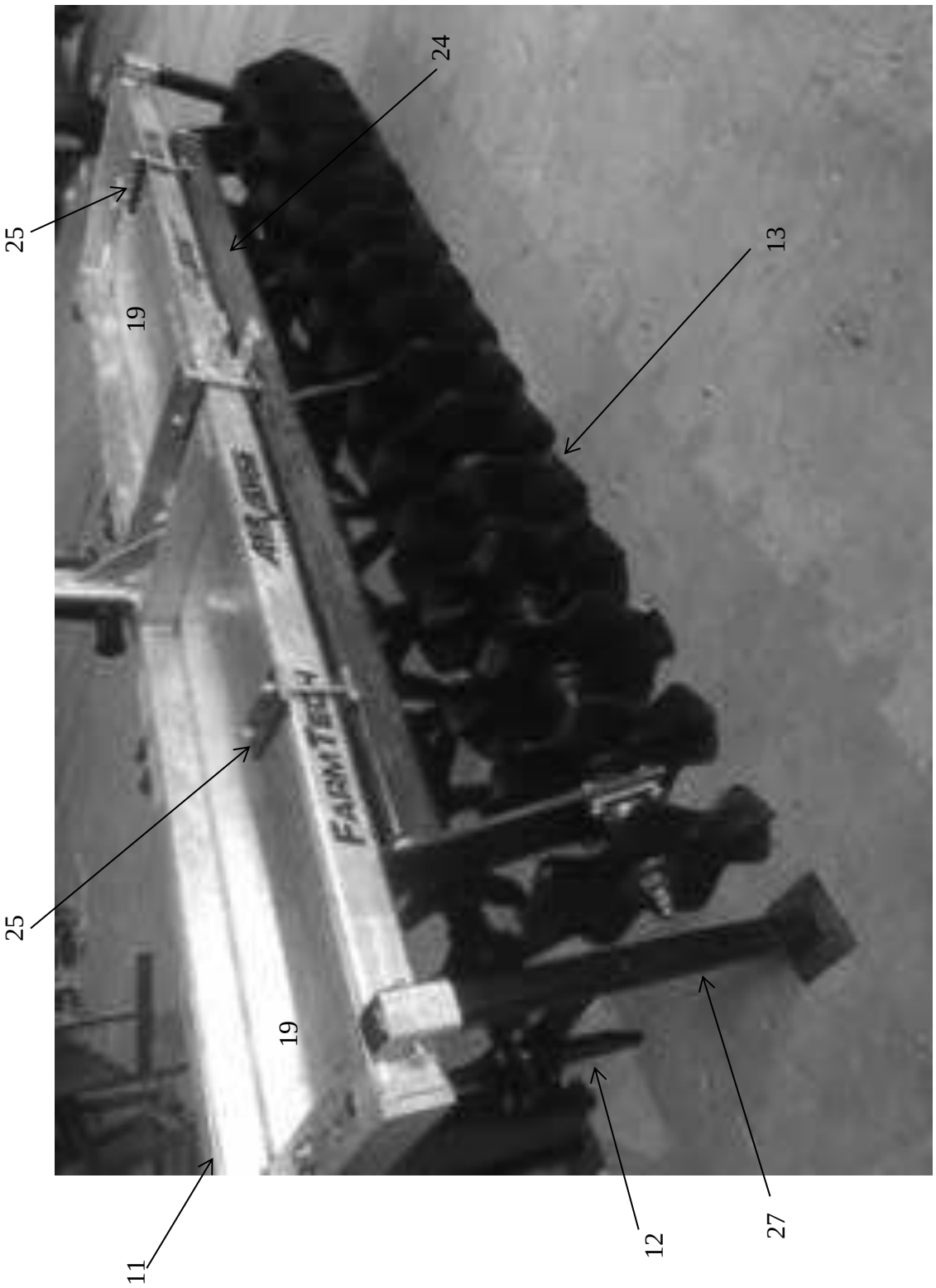

Figure 4

2017276303 14 Dec 2017

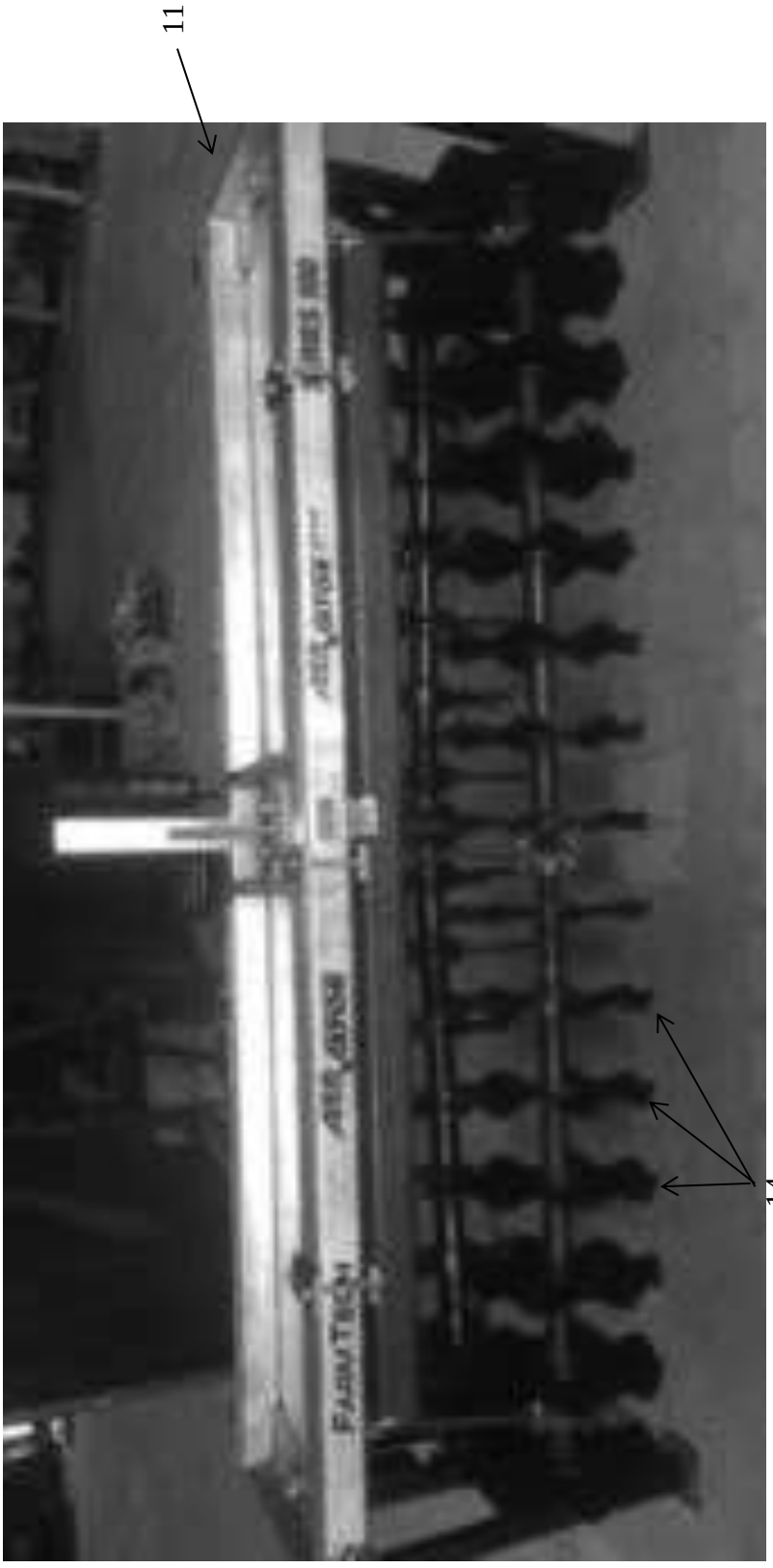

Figure 5

2017276303 14 Dec 2017

Figure 6

Figure 7

14 Dec 2017 2017276303

Figure 8

Figure 9

14 Dec 2017 2017276303

Figure 10

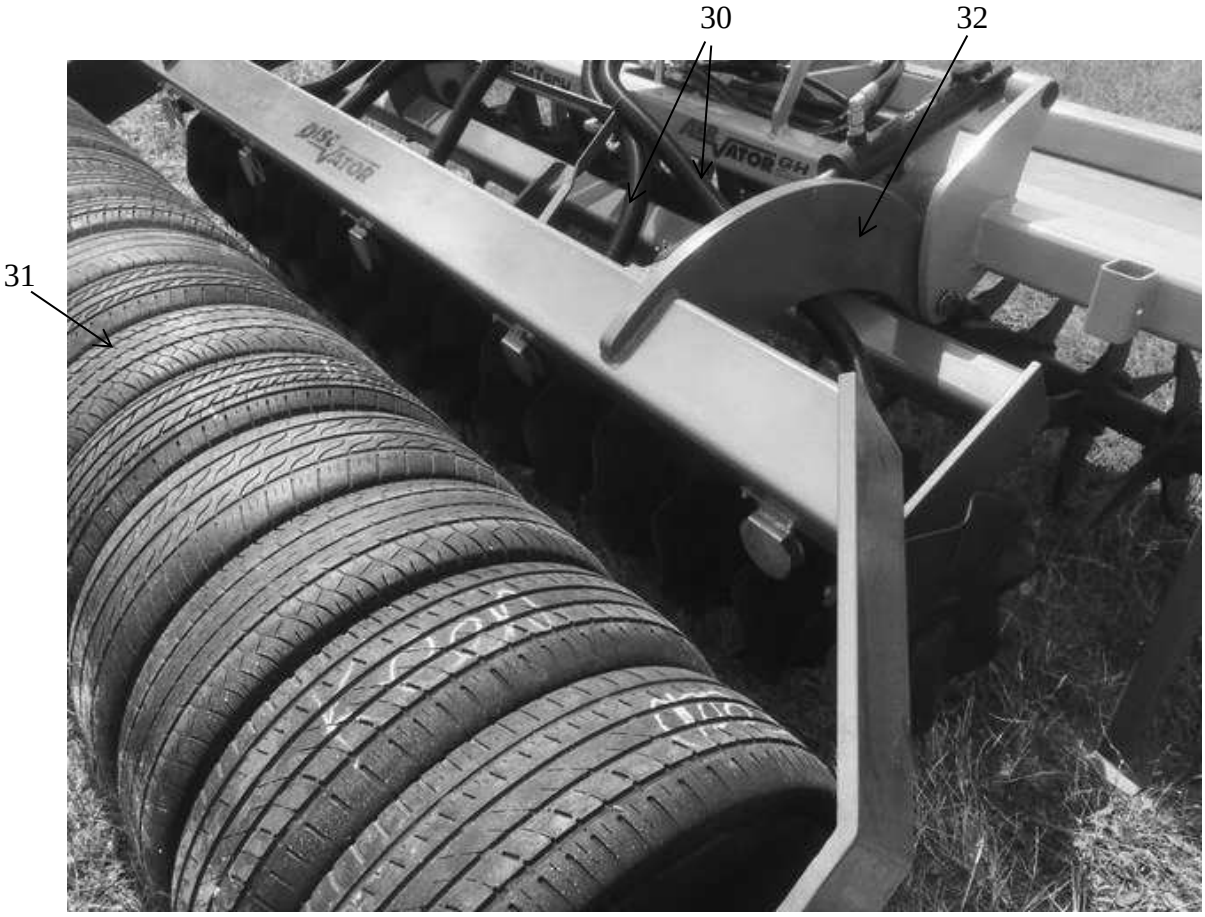

Figure 11

2017276303 14 Dec 2017

Figure 12

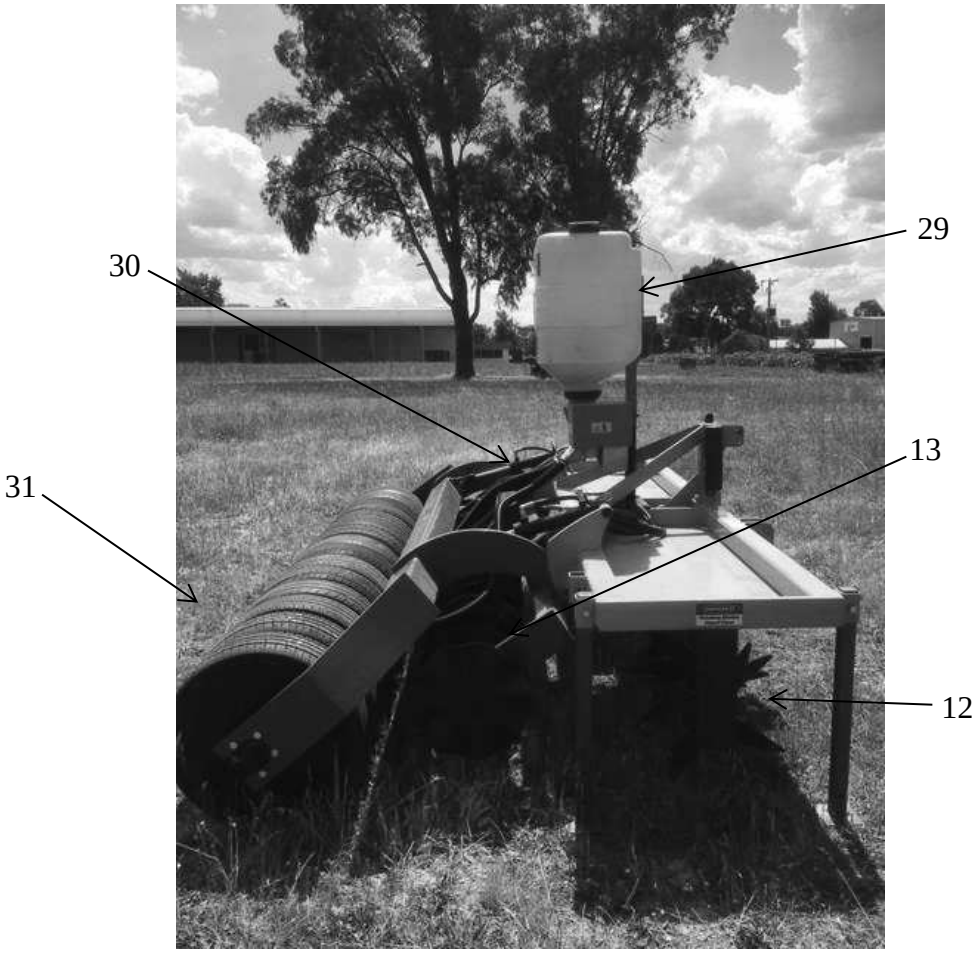

Figure 13

2017276303 14 Dec 2017

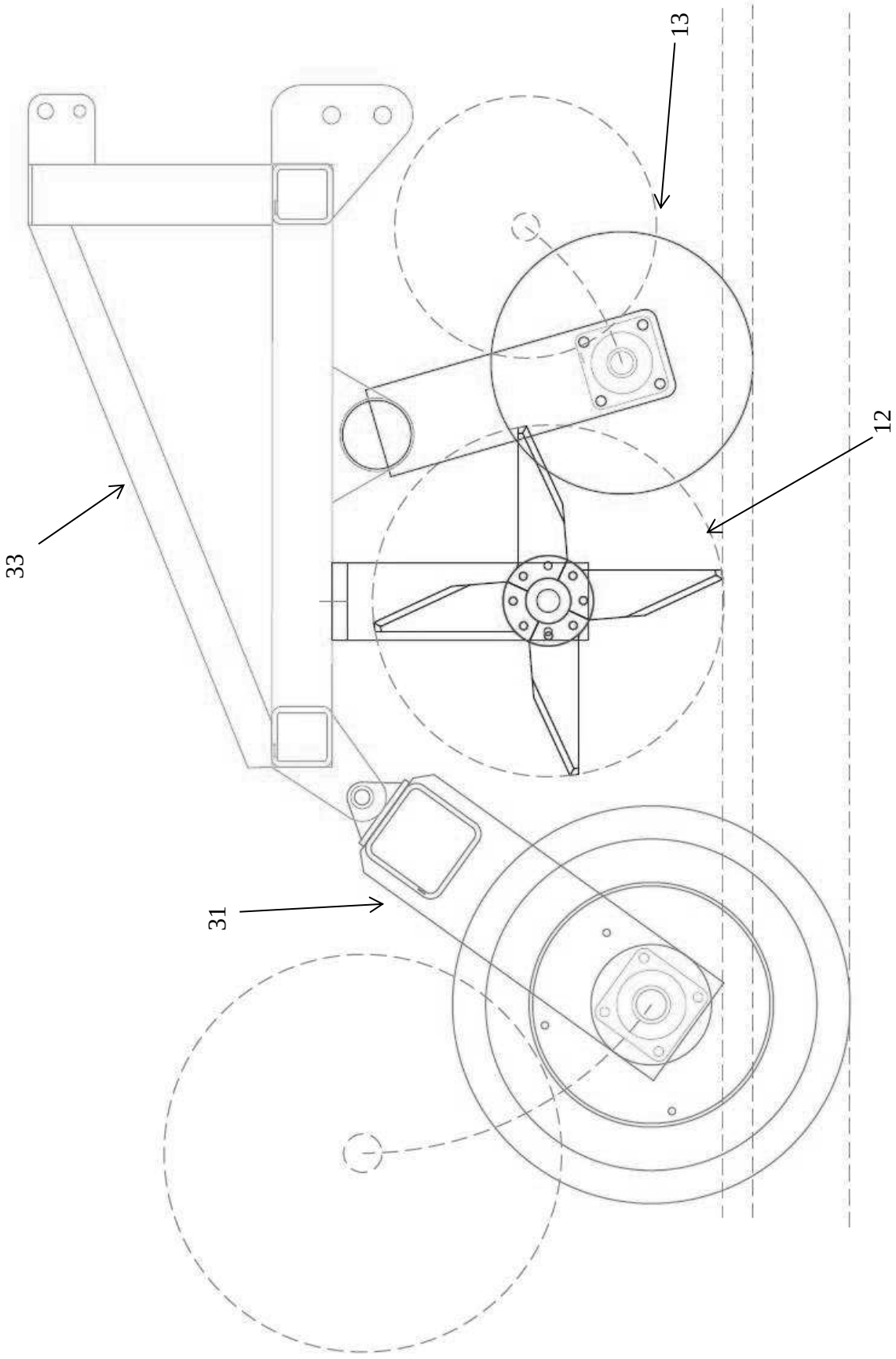

Figure 14