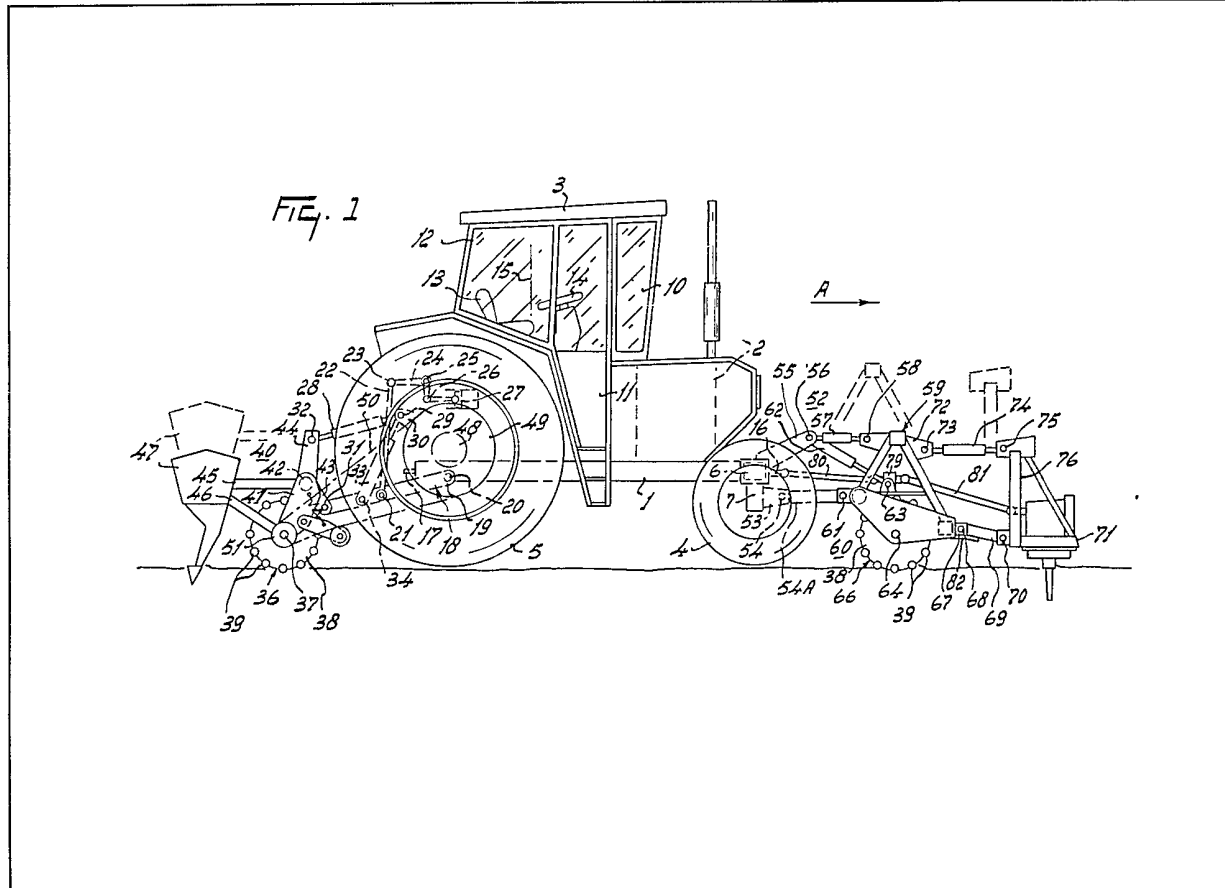


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- (54) **An agricultural assembly**
- (57) An agricultural assembly comprises a power-driven implement 47 and a power-driven roller 36 extending across substantially the width of the implement 47. The roller has a frame 40 which extends along the roller and has coupling means 43, 44 for connecting the assembly to the three-point hitch 18 at the rear of a tractor. A second power driven roller 66 is mounted at the front of the tractor, and the front and rear hitches 18, 52 include hydraulic rams 62, 33 by means of which the rollers can be pressed downwardly to carry some or all of the weight of the tractor. The implement 47 is a seed drill mounted behind the rear roller, and a rotary harrow 71 is mounted ahead of the front roller.



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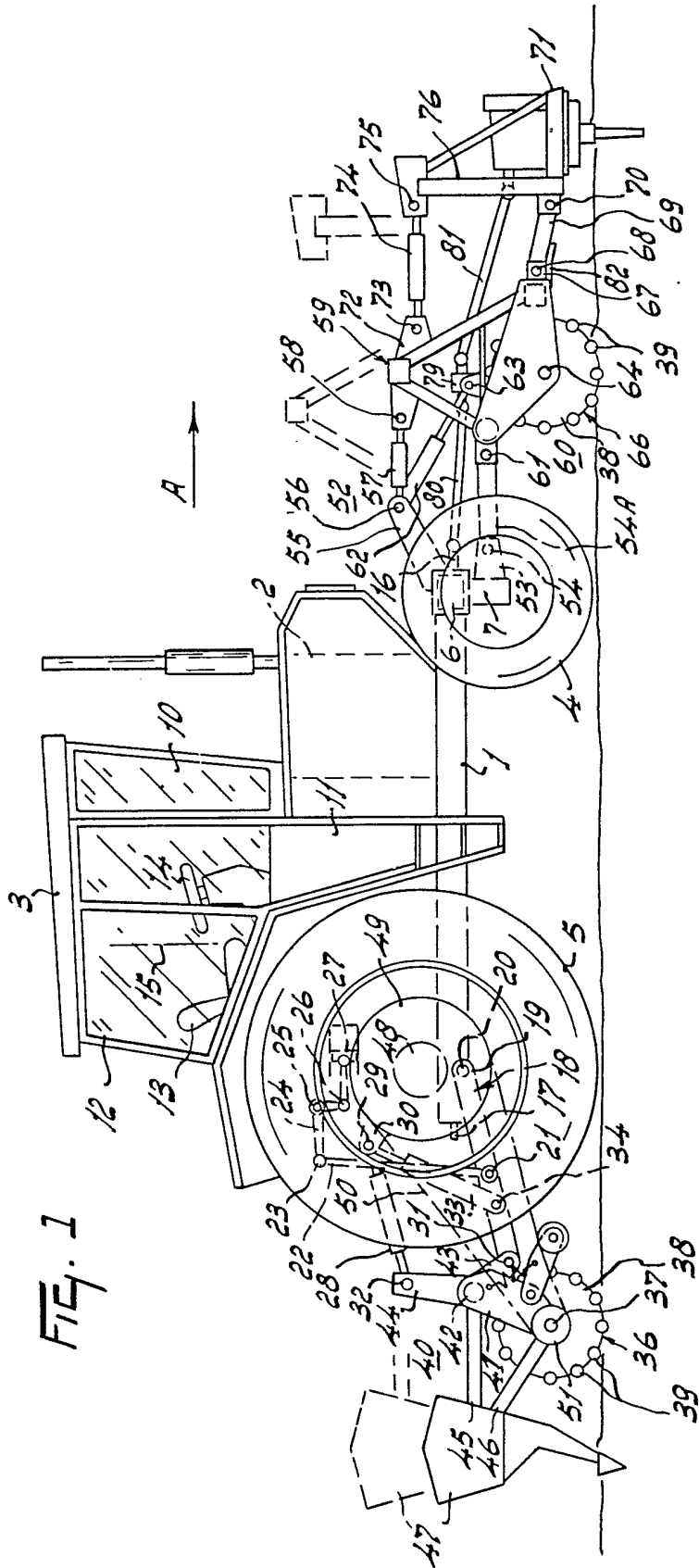


FIG. 1

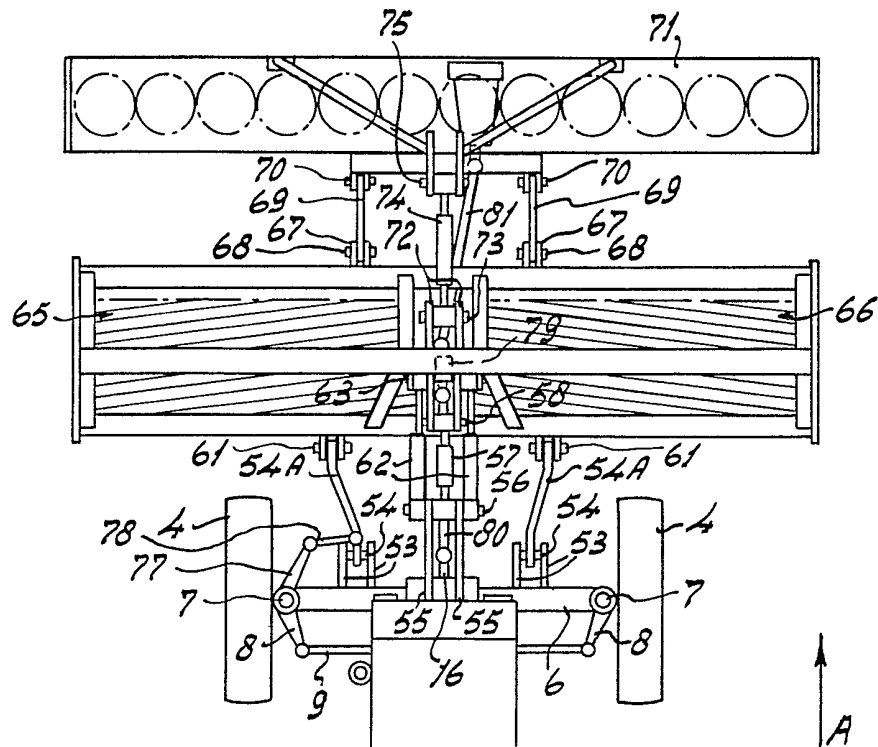
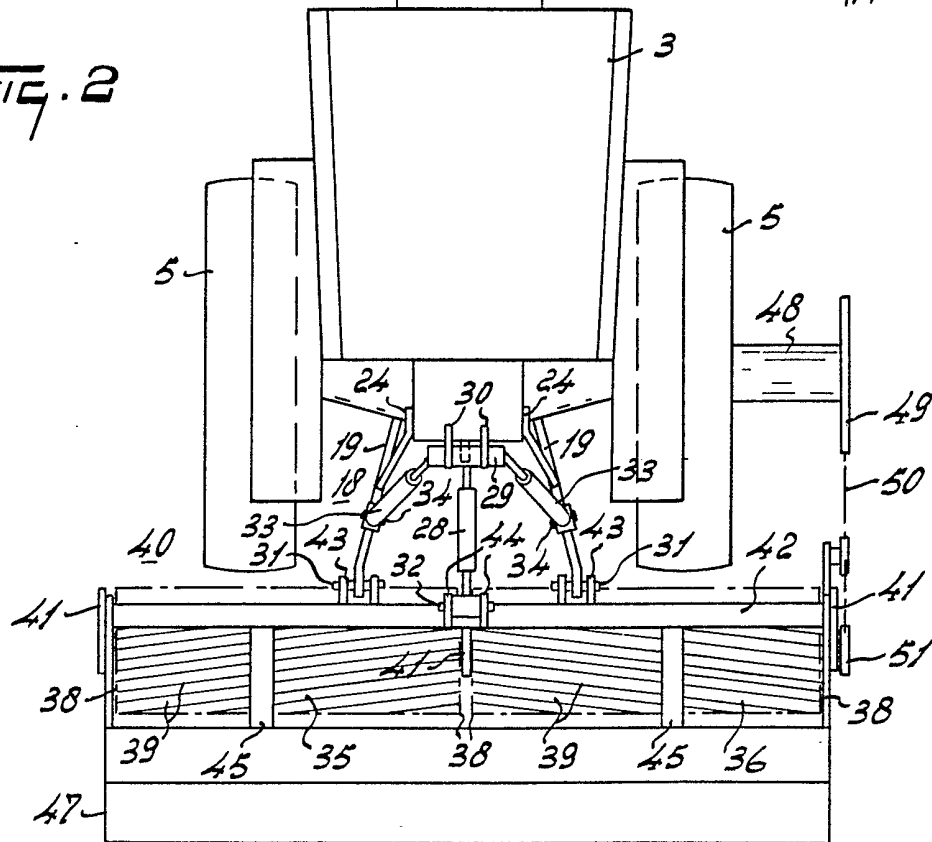


FIG. 2



SPECIFICATION

A rotary device for an agricultural assembly

5 This invention relates to a rotary device for an agricultural assembly.

According to the present invention, there is provided a power driven rotary device for use in an agricultural assembly comprising a power-driven
10 implement, the rotary device having a frame which extends along the rotary device and is provided with coupling means for connecting the rotary device to a three point hitch of a tractor.

For a better understanding of the present invention and to show how it may be carried into effect, reference will now be made, by way of example, to the accompanying drawings, in which:

Figure 1 is a side view of a tractor; and

Figure 2 is a plan view of the tractor shown in
20 *Figure 1*.

The tractor shown in *Figures 1* and *2* comprises a frame 1 on which are mounted a driving engine 2 and a driver's cab 3. The frame 1 is supported by steerable front wheels 4 and drivable rear wheels 5,
25 which can be coupled with the engine 2 by a torque converter (not shown) and a clutch. The front wheels 4 are mounted on the front axle 6, which is pivotable with respect to the frame 1 about a horizontal pivotal axis lying in the longitudinal central plane of the tractor and extending in the direction of travel
30 indicated by an arrow A. The front wheels 4 are pivotable relatively to the axle 6 about upwardly extending king pins 7, which are secured respectively near the two ends of the front axle 6. The wheels 4 are rigidly secured to track arms 8, which extend
35 from the wheels rearwardly and inwardly. The ends of the track arms away from the wheels are pivotably coupled to a track 9, which extends substantially parallel to the front axle 6 and which can be
40 displaced from the cab 3 for steering the front wheels 4. Viewed on plan, the front end of the engine 2 is located near the front axle 6. With respect to the direction of travel A, the cab 3 is located mainly
45 behind the engine 2 and comprises a front portion 10 having an internal height which is great enough to allow a person who is at least 1.80 ms high to stand upright. An entrance door 11 of the cab 3 has the same height. The rear portion of the cab 3 accommodates a driver's seat 13, a steering wheel 14 and
50 other control levers and pedals for steering and otherwise controlling the tractor and any implements hitched to it. The seat 13, the steering wheel 14 and at least some of the other controls are arranged on a console, which is pivotable about a
55 substantially vertical axis 15 with respect to the rest of the tractor.

The console, and the seat, steering wheel and other controls on it can be fixed in place with respect to the frame 1 in two positions about the axis 15
60 differing by 180°. In one of these positions, the driver faces in the direction opposite the direction A. As seen from the side (*Figure 1*), the console is located above the front part of the rear wheels 6.

The tractor has a front power take-off shaft 16 and
65 a rear power take-off shaft 17, which are driven by

the engine 2 with a speed proportional to that of the engine 2 with a speed proportional to that of the engine 2. In this embodiment provision is made for the power take-off shafts 16 and 17 to be driven at a
70 speed which is proportional to that of the driven rear wheels 5. For this purpose a change-over gear box (not shown) is provided, which has two input shafts, one of which is coupled with the engine 2 by a driver-controlled clutch and the other of which is
75 coupled, also by a clutch, with the output shaft on the torque converter.

At the rear, the tractor has a three-point lifting device 18 having two lower lifting arms 19 attached to the frame 1 for pivotal movement about pivotal
80 shafts 20. Substantially midway along their length, the lower lifting arms 19 have pivotal shafts 21, to which upwardly extending pull rods 22 are fastened, the top ends of which are pivotally coupled by shafts 23 to bell cranks 24, which are pivotable about
85 pivotal shafts 25 with respect to the frame 1. The ends of the bell cranks 24 away from the shafts 23 are connected by pivotal shafts 26 to the piston rods of hydraulic rams 27, which are pivotably mounted on the frame 1. The hydraulic rams 27 can be
90 actuated by the driver so that the pull rods 22 can turn the lower lifting arms 19 upwards. Otherwise, by opening a hydraulic connection, the driver can cause the hydraulic fluid to flow out of the hydraulic rams 27 to allow the lower lifting arms 19 to turn
95 downwards under the effect of gravity acting, for example on an attached machine. The lifting device 18 comprises furthermore an upper arm 28, the length of which is adjustable and which is pivotably connected by a pivotal shaft 29 to lugs 30 which are
100 fixed to the frame 1. The machine or the tool is hitched to the outermost ends of the lifting arms 19 and 28 by pins 31 and 32 respectively.

In addition to the components of the three-point lifting device 18 described above, there are provided
105 two hydraulic rams 33, which are disposed symmetrically with respect to the central vertical longitudinal plane of the tractor and the top ends of which are pivotably connected by the pivotal shaft 29 to the lugs 30. The lower ends of the hydraulic rams 33 are
110 pivotably connected by horizontal pivotal shafts 34 to the respective lower lifting arms 19 concerned. The orientation of the rams 33 is such that in the side elevation of *Figure 1* a line of connection between the shafts 29 and 34 is in this embodiment at an
115 angle of about 15 to 30° to the vertical, the rams 33 being inclined to the rear from top to bottom. The two hydraulic rams 33 can be actuated from the driver's seat 13 so that their lengths are increased under pressure so that the lower lifting arms 19 are
120 forcibly pressed down. The hydraulic rams 33 are provided in addition to the hydraulic three-point lifting device 18 already provided on the tractor. It is furthermore also possible for the rams 27 to be double-acting and for the linkage 21 to 26 to be
125 constructed in a manner such that the rams 27 can press the lower lifting arms 19 forcibly downwards.

A rotary support for the tractor is connected to the lifting device 18 by the pins 31 and 32. This rotary support comprises in this embodiment two rollers
130 and 36 having the same dimensions as each other,

and having aligned rotary shafts 37. The rollers 35 and 36 are arranged end-to-end and cover a width which may be 20% to 50% larger than the overall width of the tractor itself. The rollers 35 and 36 are disposed symmetrically one on each side of the central vertical longitudinal plane of the tractor. As an alternative, a single roller or more than two rollers end-to-end may be arranged to cover the width covered by the rollers 35 and 36. If more than one roller is used, the rollers may both be rigidly secured to a common rotary shaft 37, as in the embodiment shown, but embodiments are possible, in which each roller is driven independently about its own rotary shaft 37.

Each of the rollers 35 and 36 has near each end an end plate 38 supported by the rotary shaft 37. Each end plate 38 supports at its periphery a great number of rods or tubes 39 which extend helically around the rotary shaft 37, these rods or tubes 39 together providing a substantially cylindrical outer surface for each roller 35, 36. This cylindrical outer surface may, as an alternative, be formed by flat strips extending helically or axially, the faces of which constitute the outer surface of the rollers.

The rollers 35, 36 are supported by the rotary shaft 37 in a frame 40 having at its two outer ends side plates 41 the top edges of which are interconnected by a supporting beam 42 extending transversely of the direction A. The supporting beam 42 is provided with downwardly extending lugs 43, through which pass the pins 31 at the rear ends of the lower lifting arms 19. Midway along the length of the supporting beam 42 there is a pair of lugs 44 for receiving the pins 42 to connect the top arm 28 of the lifting device 18 to the supporting beam 42. The frame 40 of the rotary support is provided with rearwardly projecting carriers 45 and 46, by means of which a machine or a tool, in this embodiment a seed drill 47, is fastened to the frame 40. In this embodiment the seed drill 47 covers the whole width of the frame 40.

In this embodiment one of the wheel axles of the drivable wheels 5 of the tractor is extended by a length of tubing 48, the outer ends of which carries a chain sprocket 49 which is drivably connected by a chain 50 with a further chain sprocket 51 rigidly secured to the rotary shaft 37. The diameters of the sprockets 49 and 51 are selected so that the rollers 35 and 36 are driven by the engine 2 with a peripheral speed which is equal to that of the rear wheels 5. As an alternative, the rollers 35 and 36 may be driven by means of the power take-off shaft 17, when the latter is coupled by the aforesaid change-over gear box with the output shaft of the torque converter of the tractor.

In an analogous manner a rotary support for the tractor is hitched to a three-point lifting device 52 at the front of the tractor. In this embodiment the lifting device 52 is secured only to the front axle 6, but this lifting device may, as an alternative, be secured directly to the frame 1 of the tractor. The front axle 6 is provided with two pairs of lugs 53 projecting forwardly. Lower, lifting arms 54A are pivotably connected to the pairs of lugs 53 by aligned pivotal shafts 54. At the centre the top face of the front axle 6 is provided with a pair of lugs 55 which are inclined

forwardly from bottom to top. A top arm 57 of the lifting device is pivotally supported at the front ends of the lugs 55 by a pivotal shaft 56, which extends, like each of the pivotal shafts 54, horizontally and transversely of the direction A. The length of the top arm 57 is variable. The leading end of the top arm 57 is pivotably connected to a frame 59 by a pivotal shaft 58. The frame 59 is part of a rotary support 60 carried by the lifting device 52. The lower lifting arms 54A are pivotably connected to the frame 59 at their front ends by pivotal shafts 61. As seen from the side, the lower lifting arms 54A and the top lifting arm 57 are substantially parallel to one another and are substantially horizontal in a normal operational position of the support 60. A double-acting hydraulic ram 62 is supported at one end by the pivotal shaft 56 and the other end is pivotably connected to the frame 59 by a pivotal shaft 63. In this embodiment the hydraulic ram 62 is a double-acting ram.

The pivotal shafts 54, 56, 58, 61 and 63 are all parallel to one another and extend horizontally and transversely of the direction A. As seen from the side (Figure 1), the pivotal shafts 53, 56, 58 and 61 are located at the corners of a quadrilateral which, as shown, is almost a parallelogram. The pivotal shafts 58, 61 and 63 are all fastened to the rigid frame 59 of the rotary support 60 and are thus disposed at the corners of a rigid triangle regardless of the lengths of the hydraulic rams 62.

In the frame 59 is journaled a substantially horizontal rotary shaft 64, which is parallel to the rotary shaft 37 when the tractor is travelling in a straight line. Rotatable rollers 65 and 66 are mounted on the rotary shaft 64. The rollers 65 and 66 are arranged end-to-end. They have the same dimensions as the rollers 35 and 36 and are constructed in a similar manner. The width covered by the pair of rollers 65 and 66 is equal to that covered by the rollers 35 and 36. The rollers 65 and 66 are in front of the front wheels 4, whereas the rollers 35 and 36 are behind the rear wheels 5.

Because it is mounted on the front axle 6, the support 60 is freely pivotable with respect to the frame 1 of the tractor about the same horizontal pivotal axis located in the central vertical plane of the tractor as the front axle 6 is pivotable about.

The front of the frame 59 is provided with two pairs of lugs 67 carrying aligned pivotal shafts 68 which pivotably connect arms 69 to the frame 59. These arms 69 project forwardly from the frame 59 and are inclined slightly downwardly from back to front when in an operational position. The front ends of the carrier arms 69 are pivotally connected by aligned pivotal shafts 70 with a machine or tool which, in this case, is a rotary harrow 71. Near the top of the frame 59 there is a pair of ears 72 supporting a pivotal shaft 73 which pivotably connects an adjustable length rod 74 to the frame 59. The front end of the rod 74 is pivotably connected by a pivotal shaft 75 to the top fastening point of a trestle 76 carrying the machine 71.

About one or both of the king pins 7 is pivotable a lever 77, which, like the track arm 8, is rigidly secured to the adjacent wheel 4. The lever 77 extends forwardly away from the king pin 7 in the direction

towards the adjacent lower lifting arm 54A. The lever 77 is connected by a control link 78 with the adjacent lower lifting arm 54A, this control link 78 being pivotally connected both to the lever 77 and to the lower lifting arm 54A. The pivotal connection between the control link 78 and the lower lifting arm 54A is in front of the pivotal shaft 54.

It should be noted that the rollers 65 and 66 are rotatable independently of one another about the rotary shaft 64. In an alternative construction, the rollers 65 and 66 may be driven by the power take-off shaft 16, when the latter is coupled with the output shaft of the torque converter of the tractor. In this case there is provided a change-over gear box in a manner not shown, the input shaft of which is coupled by means of an auxiliary shaft with the power take-off shaft 16 and the output shaft of which is drivably connected through a gear transmission with the rotary shaft 64, to which the rollers 65 and 66 are then rigidly secured.

However, in the embodiment shown the frame 59 of the support 60 has fastened to it a bearing housing 79, through which passes an auxiliary shaft 80. The shaft 80 is connected at one end by a universal coupling with the power take-off shaft 16 and at the other end by a further universal coupling to a second auxiliary shaft 81. The second auxiliary shaft 81 is connected by a third universal coupling to the input shaft of the machine 71. In this way the machine 71 can be driven from the power take-off shaft 16.

In agricultural work the tracks made in the ground by the tractor wheels may often be undesirable. If, for example, a field is first harrowed before manure, fertilizer or seed is applied, the pressure of the tractor wheels on the harrowed soil locally packs the soil so that the soil structure obtained by harrowing, and in particular the distribution of capillaries, is adversely affected. After the growth of the plants this adverse effect becomes manifest. In order to obviate this disadvantage the pressure of the tractor constructed in the form shown in the Figures on the ground is reduced to such a low value that the underlying soil structure, particularly in the region of the plant roots, is maintained wholly or substantially wholly in the form obtained by harrowing. This applies not only to harrowing but also to soil treatments by means of other soil cultivating machines. It can thus be ensured that the seeds can germinate and grow in a soil structure which is not, or is only slightly, affected by the weight of the tractor.

From his seat 13 the driver can lift the rotary support at the front and/or at the rear of the tractor together with the tool (the rotary harrow 71 or the speed drill) by means of the hydraulic ram 27, which is normal tractor equipment and acts through the bell cranks 24, the pull rods 22 and the lower lifting arms 19 and the top arm 28, or by means of the double-acting hydraulic ram 62, by means of which the foremost support 60 and the machine 71 are movable relatively to the front axle 6. When a hydraulic communication in the hydraulic feed of the ram 27 is opened, the rear support and the seed drill drop to the ground under their own weight, whereas

the front support and the machine 71 can be lowered to the ground by extending the rams 62 by hydraulic pressure. However, the hydraulic ram 27 which is standard equipment is not able to exert downwards pressure on the rear support 35, 36 and on the machine 47. For this purpose the two hydraulic rams 33 are provided, which can be actuated from the driver's seat to force the lower lifting arms 19 downwardly about the pivotal shafts 20 so that, in a first instance, part of the tractor weight is taken by the rollers 35, 36. In the same manner the hydraulic rams 62 can be extended by hydraulic pressure so that the roller 65, 66 also support, in a first instance, part of the tractor weight. Thus the pressure applied by the tractor wheels 4 and 5 to the ground is reduced so that compression of the soil by the wheels 4 and 5 and the consequent deterioration of the structure is reduced because, for a given weight, the pressure exerted by the combination of the rollers 35, 36 and 65, 66 and the wheels 4, 5 is an order of magnitude lower than the pressure exerted by the wheels 4 and 5 when they provide the sole support of the tractor.

In order to improve further this advantageous effect of the reduced ground pressure, the pressure in the rams 33 and 62 can be increased by the driver to an extent such that the full weight of the tractor, the supports and the machines is taken by the rollers 35, 36 and 65, 66 so that the tractor wheels 4 and 5 no longer exert any significant pressure on the ground and may even be lifted clear of the ground. The overall weight is then distributed along the long rollers and the ground pressure is then reduced to such a low value that deterioration of the soil structure in the region of plant roots is avoided.

The height of the equipment 47 and 71 above the ground is determined by the positions of this equipment with respect to the rollers 35, 36 and 65, 66 respectively. Despite the fact that the support 60 moves with respect to the tractor when the tractor is lifted, the orientation of the frame 59 of the support 60 does not change significantly, since the pivotal shafts 54, 56, 58 and 61 are located, as viewed from the side, at the corners of what is substantially a parallelogram so that the attached machine also maintains its initial orientation. This is important for machines whose orientation with respect to the ground influences the quality of the treatment, as in the case of a rotary harrow 71. It should be noted that beneath each of the two carrier arms 69 of the harrow 71 there is a stop 82 positioned for abutment with the carrier arms 69 loaded by the weight of the tool 71. This stop 82 is rigidly fastened to the frame 59 of the support 60 and prevents the tool 71 from shifting too far downwards relative to the support 60, when, for example, the support 60 is lifted by means of the hydraulic ram 62.

When the driver wants to make a turn, the track rod 9 is displaced approximately parallel to itself so that the track arms 8 and hence also the front wheels 4 turn about the king pins 7. At the same time the lever 77 is turned about the respective king pin 7. The control link 78 connecting the lever 77 to the adjacent lower lifting arm 54A causes this lower lifting arm to turn about the associated pivotal shaft

54. This is permitted because the lower lifting arm 54A is mounted on the pivotal shaft 54 by a ball-and-socket joint. Therefore, when the front wheels 4 turn about the shafts 7 the rotary support 5 60 of the tractor will turn likewise so that the support 60 guides the tractor round the bend regardless of whether or not the front wheels 4 are in contact with the ground. The machine 71 coupled to the front of the support 60 is turned at the same time and 10 steered through the bend. During operation, the assembly of the support 60 and the machine 71 is pivotable with respect to the tractor frame about the pivotal axis about which the front axle 6 is pivotable so that the support 60 and the machine 71 can follow 15 unevennesses of the ground independently of the rear roller 35, 36.

The torque converter which transmits power between the engine 2 and the driven wheels 5 comprises at least one variable belt transmission and, in 20 addition, a stepwise change-speed gearbox, which is arranged between the variable belt transmission and the axle of the wheels 5. The construction of this torque converter can correspond with that described in our co-pending patent application No. 8007976 25 (Serial No. 2046683). With the elements of the torque converter disposed as described in the application, an advantageous load of the belt transmission is obtained with differently adjusted transmission ratios of the stepwise change-speed gearbox so that 30 for each transmission ratio set in the change-speed gearbox (for example, to provide a range of low speeds for exerting high tractive power and a range of higher speeds for actuating light machines or for road travel) the pulley speed of the belt transmission 35 can be adjusted steplessly to transmit maximum torque and/or power.

The tractor can be used in either direction of travel so that, depending upon the circumstances, the driven rotary support can be disposed at the front or 40 at the rear of the tractor, with respect to the actual travel direction, and also in front of or behind the implement. Apart from the nature of the implement (it is sometimes preferable to employ implements hitched to the front of the tractor) the necessity that 45 the driver is able to supervise the job must also be a consideration. Depending, therefore, on whether or not the driven rotary support and the implement to be used is to be at the front or at the rear of the tractor, the driver's seat and the steering wheel and 50 other controls mounted on the console can be turned about the pivotal axis 15 to face the driver in the direction A or in the opposite direction.

Whilst various features of the tractor that have been described, and that are illustrated in the 55 drawings, will be set forth in the following claims as inventive features, it is to be noted that the invention is not necessarily limited to these features and that it encompasses all of the features that have been described both individually and in various combina- 60 tions.

CLAIMS

1. A power driven rotary device for use in an 65 agricultural assembly comprising a power-driven

implement, the rotary device having a frame which extends along the rotary device and is provided with coupling means for connecting the rotary device to a three point hitch of a tractor.

70 2. A rotary device as claimed in claim 1, in which the frame comprises a beam extending along the rotary support.

75 3. A rotary device as claimed in claim 1 or 2, in which an end plate is provided at each end of the rotary device, each end plate being supported on a shaft.

4. A rotary device as claimed in claim 3, which is drivably connected to the shaft.

80 5. A rotary device as claimed in any one of the preceding claims, in which drive is imparted to the rotary device at one end of the rotary device.

6. A rotary device as claimed in any one of the preceding claims, which comprises two rollers.

85 7. A rotary device as claimed in claim 5, in which the rollers are coaxial and arranged end to end.

8. A rotary device as claimed in any one of the preceding claims, which is adapted to be connected to be driven by an engine of a tractor to which the rotary support is coupled.

90 9. A rotary device as claimed in claim 8, which is adapted to be connected to be driven from a power take-off shaft of the tractor.

10. A rotary device as claimed in claim 8, which is drivable by an associated motor.

95 11. An agricultural assembly comprising a power driven implement and a rotary device in accordance with any one of the preceding claims, the rotary device extending over the full width, or approximately the full width, of the implement.