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(73) Patenthaver: **Lemken GmbH & Co. KG, Weseler Strasse 5, 46519 Alpen, Tyskland**

(72) Opfinder: **Siebers, Josef, Dorsewald 14, 46509 Xanten, Tyskland**

(74) Fuldmægtig i Danmark: **NORDIC PATENT SERVICE A/S, Bredgade 30, 1260 København K, Danmark**

(54) Benævnelse: **VENDEPLOV MED SVINGBART STØTTEHJUL TIL MONTERING PÅ PLOVRAMMEN**

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DE-U1- 8 532 966
DE-U1- 29 919 028

The invention relates to a pivoting support wheel for mounting on a plow frame of a rotary plow according to the preamble of claim 1.

Rotary plows are usually provided with support wheels on the plow frame to provide a distance of the plow frame from the ground surface and thus the penetration depth of the plow tools into the ground. Since the plow frame is angled obliquely to the direction of travel in the working position, support wheels pivot in the direction of travel during the rotary movement of the plow frame. in their pivoting movement, these require a smaller clearance with respect to the plow frame than support wheels which pivot in the opposite direction to the direction of travel if these are not arranged at the end of the plow frame. in principle, however, the pivot arm of these support wheels is inclined backwards in the working position, since self-stabilization and self-alignment of the wheels takes place precisely with changing forces on the support wheels. This improves or makes possible a stable and exact lateral guidance of the plow tools, as shown in the German patent application DE 30 33 791. in order to move the pivot arm backwards when the support wheel is placed on the ground in forwards travel, the support wheel is provided with an extension as a ground spike or it is provided with a braking device or the like, as for example disclosed in DE 75 38 474 U1 or DE 25 54 273 C2. A further pendulum support wheel as disclosed in DE 25 45 009 C3 may be perpendicularly pivoted about an axis in order to serve as a freely-rotating transport wheel in a middle transport position of the plow frame. Since these support wheels occasionally pivot forward upon touching the ground and do not fulfill their depth control function, support wheels have been implemented which basically pivot counter to the direction of travel, but need a larger pivoting clearance relative to the plow frame, but which then lacks ground clearance when turning the lifted plow. The German utility model DE 8 532 966 U1 proposes a pendulum support wheel, which is arranged behind the plow frame. In order to allow for boundary plowing, the support wheel may be temporarily folded forward about a vertical axis. As previously described, however, this displaced position causes an unstable lateral guidance of the plow tools, which leaves a bad and uneven plow pattern in the final furrow. The

German utility model DE 299 19 028 U1 proposes a pushed support wheel with the same disadvantages.

It is an object of the invention to provide a pivoting support wheel which avoids the above-mentioned drawbacks but combines the respective advantages. This object is achieved by the features of the characterizing part of claim 1.

When the plow or the plow frame is turned, the pivoting support wheel describes a semicircular segment, which, viewed from the side, lies in a front region in front of the pivot axis, through the movement of the pivot arm and thus of the pivoting support wheel exclusively in the direction of travel, i.e. in the direction of the towing vehicle. The pivoting support wheel thus always remains in a pushed position and may be fixed in the working position by at least one limit stop until the next pivoting Operation. As a result of the preferably free, or at least partially free, rotation of the pivot arm or the pivoting support wheel about the second axis, which is preferably at least approximately perpendicular to the first axis, the support wheel exhibits self-steering characteristics which have different support or steering forces which act on the support wheel or the plow frame through the pushed or forwardly-directed arrangement of the pivot arm, and thus enable an exact lateral guidance of the plow.

In an extended embodiment, the pivoting movement of the arm or the support wheel about the second axis is shifted from a middle position to the right and to the left at a pivotangle of a maximum of 60°. By means of this limitation, the support wheel can not deflect completely freely to the left or right, but rather from the middle part, which forms the optimum direction of travel of the support wheel during plowing work. When the support wheel is placed on the ground at the beginning of the plowing work, the freely-pivoting wheel quickly pivots into the middle section. The limitation may be accomplished by stops or by spring means. The latter have the advantage that the support wheel is already placed prealigned on the ground in the direction of travel, but may pivot against the spring force.

If, as described above, the rotation angle of the support wheel is limited to a pivoting angle of a maximum of 20° outside the middle section, the lateral steerability is restricted, but the lateral pivoting of the support wheel from the plow frame is reduced.

The space requirement of the pivoting support wheel may be moved still further into the plow frame or arranged further back on the plow frame.

In an improved embodiment, the arm or the pivot bearing is designed to be telescopic or displaceable in the direction of the second axis. In addition to the pivot stops about the first axis, a further fine adjustment facility is provided for the working depth adjustment of the plow bodies. It is expedient to push the pivot arm through the pivot bearing, which forms the second axis, or to displace it parallel to this axis. This may be achieved by means of a telescopic tube, a link guide, but also by means of a multi-joint arrangement in the form, for example, of a parallelogram.

In another embodiment, the pivoting support wheel, the pivot bearing or the pivot arm is mounted to pivot about a third axis which is arranged approximately perpendicular to the ground surface or to the plane of symmetry of the plow frame. This design enables the angles of the device to the plow frame to be adjusted to different angles of the plow frame relative to the direction of travel as viewed from above.

In a simple embodiment, the third axis, about which the pivot support wheel, the pivot bearing or the pivot arm is mounted to pivot, corresponds to the pivot axis of a plow body or pair of plow bodies. As a result of this design, the pivot bearing of the plow body may be used to adjust the latter's cutting width as a pivot bearing for angular adjustment of the pivoting support wheel with respect to the plow frame when viewed from above. As a result, the device always remains parallel to the plow tool and thus to the direction of travel.

In a particularly operationally reliable embodiment of the invention, means are arranged on the arm or on the plow frame to limit the pivoting speed of the pivoting support wheel about the first and/or secend axis. For example, the dynamics which occur during the turning of the entire plow frarne and thus during the pivoting of the support wheel is dampened by darnping cylinders, friction disks or other suitable elements.

In a convenient embodiment according to the invention, the pivoting movement of the pivoting support wheel about the first and/or second axis is supported or blocked by at least one external power device. For example, the

pivoting operation of the support wheel may be effected by a hydraulic cylinder in a time-controlled and defined manner during the turning of the plow. In addition, remote actuation, for example, through hydraulic cylinders or other servomotors also allows convenient working depth adjustment of the plow bodies during travel by changing the pivot angle of the pivoting support wheel about the first axis.

In another embodiment, the movement of the pivoting support wheel or the arm about the second axis may be fixed through locking means in a position at 90° to the middle position. By means of this arrangement, the support wheel may be fixed about the second axis into a position parallel to the plane of symmetry of the plow frame. In the case of a middle transport position of the plow frame, the pivoting support wheel may follow around the first axis and carry part of the plow weight during road travel when the pivot angle limiter about the first axis is deactivated.

In a preferred form of the invention, the pivoting support wheel is mounted near the last, or next to last, plow body. The further the pivoting support wheel is from the towing tractor, the more plow weight may be taken up by the three-point linkage of the tractor instead of via the support wheel, by increasing loading on the rear axle of the tractor.

This supporting wheel arrangement is particularly suitable for plows projecting far behind, such as multi-plowbody mounted reversible plows or semi-mounted reversible plows with a movable rear part.

The invention is distinguished in particular by the fact that the space required for the support wheel of a plow as a result of using a pushed pivoting support wheel, may be reduced both with respect to the plow frame and its attachments as well as with respect to the ground surface during the pivoting or turning process. In addition, border plowing close to fencing or road boundaries is facilitated by the pushed support wheel which is less laterally prominent to the direction of travel. Due to the smaller lateral prominence of the pivoting support wheel, levers, arms, brackets and bearings may also be designed to be smaller, lighter and more cost-effective.

Further details and advantages of the subject matter of the invention may be gathered from the following description and the associated drawings, wherein an exemplary embodiment with the necessary details is shown:

Fig. 1 shows a rotary plow construction in a side elevation view from the left

Fig. 2 shows a top plan view of a rotary plow construction

Fig. 3 shows the rear region of a rotary plow construction with a pivoting support wheel in a perspective view.

Fig. 1 shows a rotary plow 1 in a side view. This is a rotary plow construction, which is coupled via the mounting frame 14 as well as its upper and lower coupling points 16, 17 to the three-point linkage of a towing tractor (not shown) which carries and pulls the rotary plow. The rotary plow 1 may be moved from a lowered work position into a raised position for transporting or turning the plow via the three-point linkage of a towing tractor. In order to turn the plow, the plow frame 3 is pivotable by means of a hydraulic cylinder 15 or other devices through an angle of approximately 180° from a right-handed position to a left-handed position about an axis of rotation 18 which is rotatably mounted in the mounting frame 14. For this purpose, the hydraulic cylinder 15 is connected on one side to the mounting frame 14, while it is pivotally connected to the plowing frame 3 at its other end via a lever at a distance from the axis 18. in a middle position, the plow frame 3 may be locked with the mounting frame 14, for example, via a locking pin for transport purposes. A plurality of right-handed and left-handed plow tools 4, 4' are fastened to the plow frame 3 at a distance behind one another. Right-handed and a left-handed plow tools 4, 4' respectively form a preferably symmetrically- constructed fixing unit above the middle plane 20 of the plow frame 4. in the working position, the rotary plow 1 is drawn through the ground in the direction of travel. The direction of travel of the tractor pulling the plow in the working position is designated as the direction of travel. The plow tools 4, 4' accordingly cut a part of the ground below the ground surface 7 and turn it to the side. in the front region, the working depth

of the plow tools is predetermined by the three-point linkage of the towing tractor and, in the rear region, by the position of the support wheel 2 between the ground surface 7 and the plow frame 3. The distance of the support wheel 5 from the middle plane 20 of the plow frame 3 or from the ground surface 7 may be adjusted by a change in the angle of incidence (1/2 α) of the pivot arm 6 which is spanned by the axis 9 and the middle plane 20, which preferably intersects the plow frame 3 horizontally and symmetrically 7. in this way, the maximum working depth in the ground of the plow bodies 4, 4' is changed. The angular position may be set as the end position in the working position by means of the abutment means 13, 13'. The abutment means 13, 13' may be designed as variable- length threaded spindles, combinations of perforated strips and locking pins, but also as unlockable hydraulic cylinders or other single or double acting servomotors. The servomotor or hydraulic cylinder may at the same time reduce or regulate the pivoting speed. The support wheel 5 forms the wheel contact point 10 in the working position by lowering the rotary plow 1 to the ground surface 7. The intersection point 11, which is formed by the forwardly-inclined extended pivot axis 9 and the ground surface 7, is spaced from the wheel contact point 10 in the direction of travel to form a guidance point, according to which the wheel 5 follows in a self-aligning manner. The pivot angle α, which describes the movement of the support wheel in the direction of travel, should not exceed a maximum angle of 160° so that the support wheel does not pivot backwards, or remains in a vertical position. An angle of inclination a of less than 60° is also less suitable, since the intersection point 11 of the axis 9 with the ground surface 7 is then too far forward from the wheel contact point 10 and results in unstable wheel guidance.

Fig. 2 shows the above-described rotary plow in plan view and in the working position. The upper and lower links (not shown) of the three-point linkage hydraulics of the tractor are attached to the mounting frame 14 at the coupling points 16, 17, 17' that are provided for this purpose. As previously described, the plow frame 3, with its plow bodies 4, 4' fastened thereto, may be pivoted about the turning axis 18 from a shown right-hand turning to a left-hand turning position, preferably by means of the hydraulic cylinder 15. The plow frame 3 is connected to the turning axis 18 to be laterally movable by means of

a link 23 as well as pin bearings. The front furrow width and the pulling point of the plow may be adjusted via an adjustment center 22 by means of Servomotors or spindles. Slide guides for lateral movement of the plow frame are also possible. The rear end of the plow frame 3 may be pivoted further centrally to the axis 18 by means of a pivoting cylinder 24 in order to increase the ground clearance of the raised plow during turning. A further servomotor 25 is provided to pivot the plow frame with parallel adjustment of the cutting width of the individual plow bodies 4, 4'. The pivoting support wheel 2 is laterally pivotable about the axis 19 on the plow frame in the rear region of the plow frame 3. A parallel guide to adjust the cutting width of the individual plow bodies 4, 4' by pivoting about the axis 21, 21' is made possible by a linkage (not shown). The pivoting arm 6 and the support wheel 5 are mounted to rotate about the axis 9, which is inclined with respect to the ground and points forwards. From this pivot bearing, the pivot arm 6 encompasses the tire of the support wheel 5 and dips centrally in its rim.

A wheel hub that is not visible is rotatably mounted on the pivot arm 6 within the rim to allow the support wheel 5 to roll on the ground surface. The pitch line of the pivot arm 6 is almost the same as the axis 9, but may slightly deviate therefrom. It is important that the axis 9 approximately intersects the middle plane of the wheel that is vertical to the wheel's running axis, at the level of the ground surface, wherein this intersection point lies in the direction of travel or of the towing tractor at a distance from the wheel contact point.

The use of twin or double wheels is also conceivable, wherein the axis 9 or the above-described middle plane preferably lies centrally between these wheels. Likewise, the intersection point 11 and the wheel contact point 10 are formed at least approximately centrally between these wheels. The pivoting axis 8 of the pivot bearing 12 is at least approximately perpendicular to the direction of travel, but may also be erected further with respect to the longitudinal axis of the plow frame 3 in order to need less pivoting free space with respect to the ground surface. In this case, the at least approximately vertical alignment of the axis 9 with respect to the axis 8 must be compensated for in a complementary manner according to the direction of travel.

Fig. 3 shows the pivoting support wheel 2 with the rear part of the rotary plow 1 in the working position. The pivot bearing is mounted on the plow frame 3 to pivot laterally about the axis 19. The pivoting support wheel 2 may be aligned at an approximately equal angle parallel to the direction of travel corresponding to the angular position of the plow frame 3 relative to the direction of travel. This alignment may be performed manually, for example, by changing over a pin or other adjusting means, or automatically through a parallel guiding device. To a certain extent, a fixed angular position deviating from the direction of travel is also possible, insofar as it may be compensated for by the self-steering or trailing characteristics of the pivoting support wheel 2. This applies to all the axis alignments which influence the function of the pivoting support wheel 2. The plow bodies 4, 4' and their holding brackets are rotatably mounted on the plow frame 3 via the pivoting axes 21, 21'. The plow bodies 4, 4' are aligned in the direction of travel by means of a parallel guide linkage, thus making possible a variable cutting width adjustment of the rotary plow 1 or its plow bodies 4, 4'. Ideally, the pivoting support wheel 2 or its pivot bearing 12 is coupled to this parallel guide or is fastened directly to one of the pivot bearings 21, 21' and likewise aligned in the direction of travel. In the working position shown, the pivoting support wheel 2 is fixed against a limit stop of the pivot bearings 12 by a stop means 13', which is designed as a tiltable stop spindle. When the plow is turned, the stop means 13' falls into an inactive position. The pivoting support wheel 2 may pivot about the axis 8 into an opposing position in which it is fixed again by the opposing stop means 13 serving the same function. Likewise, the use of servomotors, for example an unlockable hydraulic cylinder or other locking means to fix the pivoting support wheel and to preset a working depth of the rotary plow 1 is possible.

The lateral forces which act on the support wheel 51 at the wheel contact point 10 when the rotary plow 1 is in operation, direct the latter in the direction of travel with an effective lever spacing, which is formed between the axis 9 and the wheel contact point 10. The intersection point 11 of the axis 9 with the ground surface thus forms the imaginary guide point, around which the support wheel 5 follows. The support wheel 5 may be a tire with a rim, but also a steel wheel or have a roller shape. The support wheel may also be provided

with a circumferential guide web or profile which improves the steering or rolling characteristics on the ground.

List of reference numbers

1	Rotary plow
2	Pivoting support wheel
3	Plow frame
4	Plow tool, plow body
5	Support wheel
6	Arm, pivotarm
7	Ground, ground
8	Axis, pivot axis
9	Axis, steering axis
10	Wheel contact point
11	Intersection point
12	Pivot bearing
13	Stop means
14	Mounting frame
15	Hydraulic cylinder
16	Coupling point
17	Coupling point
18	Turning axis
19	Axis, pivot axis
20	Middle plane
21	Axis, pivot axis
22	Adjustment center
23	Link
24	Pivot cylinder
25	Servomotor

Patentkrav

1. Vendeplov (1) med svingbart støttehjul (2) til montering på vendeplovens (1) plovramme (3), idet plovrammen (3) med flere plovlegemer (4,4'), der er monteret spejlvendt parvist over for hinanden, via en drejning på næsten 180 grader kan bringes fra en venstregående til en højregående position, idet der på plovrammen (3) er anbragt mindst et støttehjul (5) til dybdebegrænsning af plovlegemerne (4,4'), hvilket støttehjul via en arm (6) er svingbart lejret, idet armen (6) til lejring af støttehjulet (5) omkring en første akse (8), der i det mindste forløber omtrent parallelt med jordoverfladen (7) eller i det mindste omtrent gennem plovrammens (3) midterplan (20), ved plovrammens (3) drejning roterer begrænset i sin svingvinkel og efter denne rotation ved hjælp af en yderligere indretning kan låses i en respektiv arbejdsstilling, der svarer til plovhældningen, idet armens (6) bevægelse omkring den første akse (8) sker i kørselsretningen eller fremadrettet og tegner en maksimal svingvinkel (α) på 160 grader, idet en anden akse (9), som er anbragt i det mindste omtrent gennem et plan, der forløber vinkelret på jordoverfladen (7) og i det mindste omtrent parallelt med kørselsretningen, idet den anden akse (9), der hælder fremad, er anbragt foran hjulkontaktpunktet (10), idet den danner et snitpunkt (11) med jordoverfladen (7), hvilket snitpunkt danner det tænkte føringspunkt, omkring hvilket støttehjulet (5) løber,
kendetegnet ved, at armen (6) eller støttehjulet (5) er lejret drejeligt omkring den anden akse (9).

2. Vendeplov med svingbart støttehjul ifølge krav 1,
kendetegnet ved,
at armens (6) eller støttehjulets (5) svingbevægelse omkring den anden akse (9) er begrænset af en midterstilling mod højre og venstre til en respektiv svingvinkel på maks. 60 grader.

3. Vendeplov med svingbart støttehjul ifølge krav 2,
kendetegnet ved,
at svingbevægelsen omkring den anden akse (9) er begrænset af en midterposition mod højre og venstre til en respektiv svingvinkel på maks. 20 grader.

4. Vendeplov med svingbart støttehjul ifølge krav 1, 2 eller 3,
kendetegnet ved,
at armen (6) eller svinglejet (12) er udført teleskoperbart eller forskydeligt i retning mod den anden akse (9) .

5. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav,
kendetegnet ved,
at det svingbare støttehjul (2), svinglejet (12) eller armen (6) er lejret svingbart omkring en tredje akse (19), som er anbragt omtrent vinkelret på jordoverfladen (7) eller på plovrammens (4) symmetriplan (20).

6. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav,
kendetegnet ved,
at den tredje akse (19), om hvilken det svingbare støttehjul (2), svinglejet (12) eller armen (6) er lejret svingbart, svarer til et plovlegemes (4,4') eller et plovlegemepars svingakse (21, 21') .

7. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav,
kendetegnet ved,
at der er anbragt komponenter på armen (6) eller plovrammen (3), som begrænser det svingbare støttehjuls (2) eller armens (6) svinghastighed omkring den første og/eller anden akse (8,9).

8. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav,
kendetegnet ved,
at det svingbare støttehjuls (2) svingbevægelse omkring den første og/eller anden akse (8,9) er udført understøttende eller blokerende ved hjælp af mindst en ekstern drivkraftanordning.

9. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav,
kendetegnet ved,
at det svingbare støttehjuls (2) eller armens (6) svingbevægelse omkring den anden akse (9) ved hjælp af låsekomponenter er udført til at kunne fastgøres i en stilling,

der er drejet 90 grader i forhold til midterpositionen.

10. Vendeplov med svingbart støttehjul ifølge mindst et af de foregående krav, **kendetegnet ved,**

at det svingbare støttehjul (2) er fastgjort i nærheden af det sidste eller næstsidste plovlegeme (4,4').

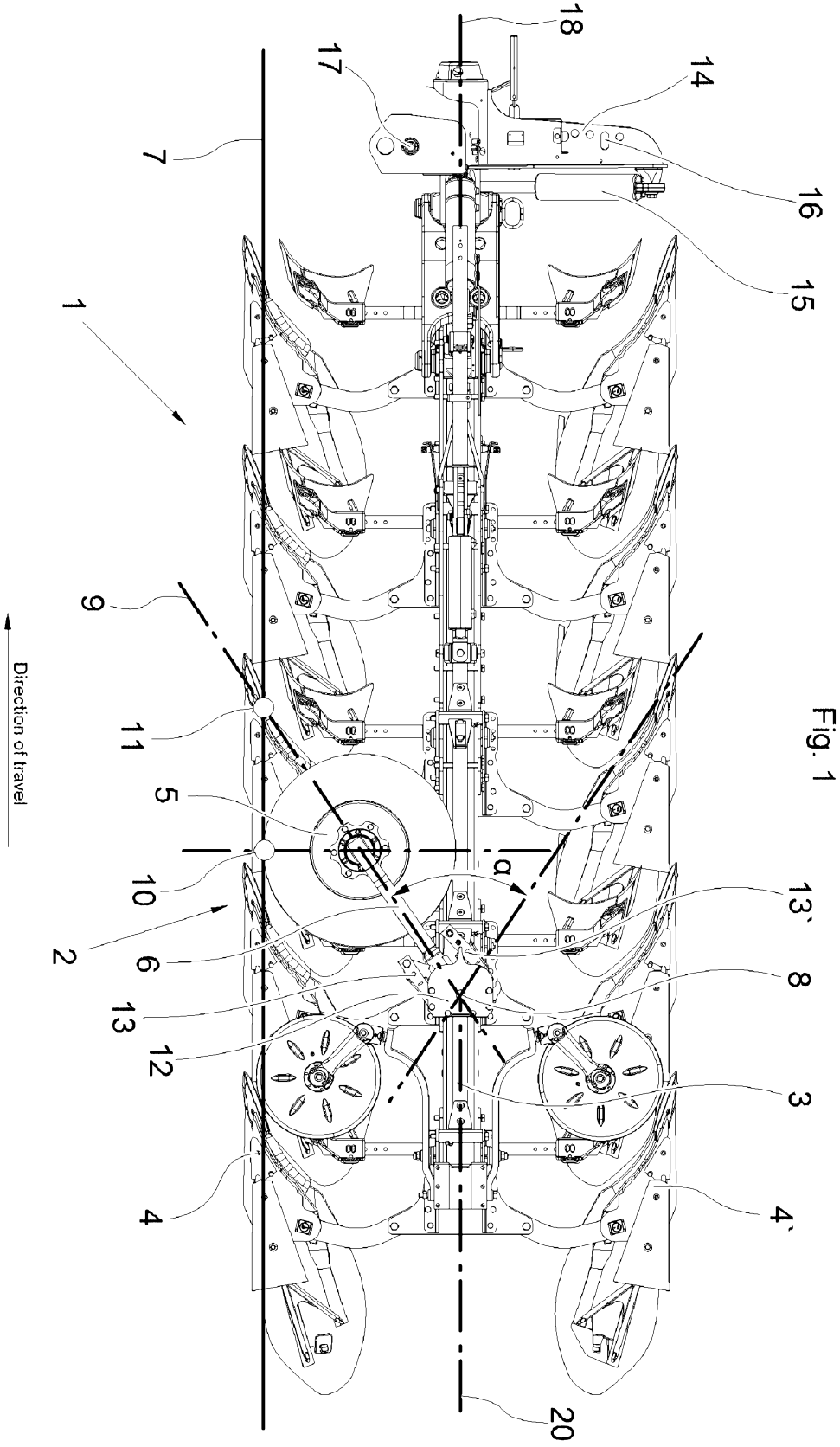
18
17
14
7
16
15
1
9
11
5
10
2
6
13
12
α
13`
8
3
4
4`
20
Direction of travel

Fig. 1

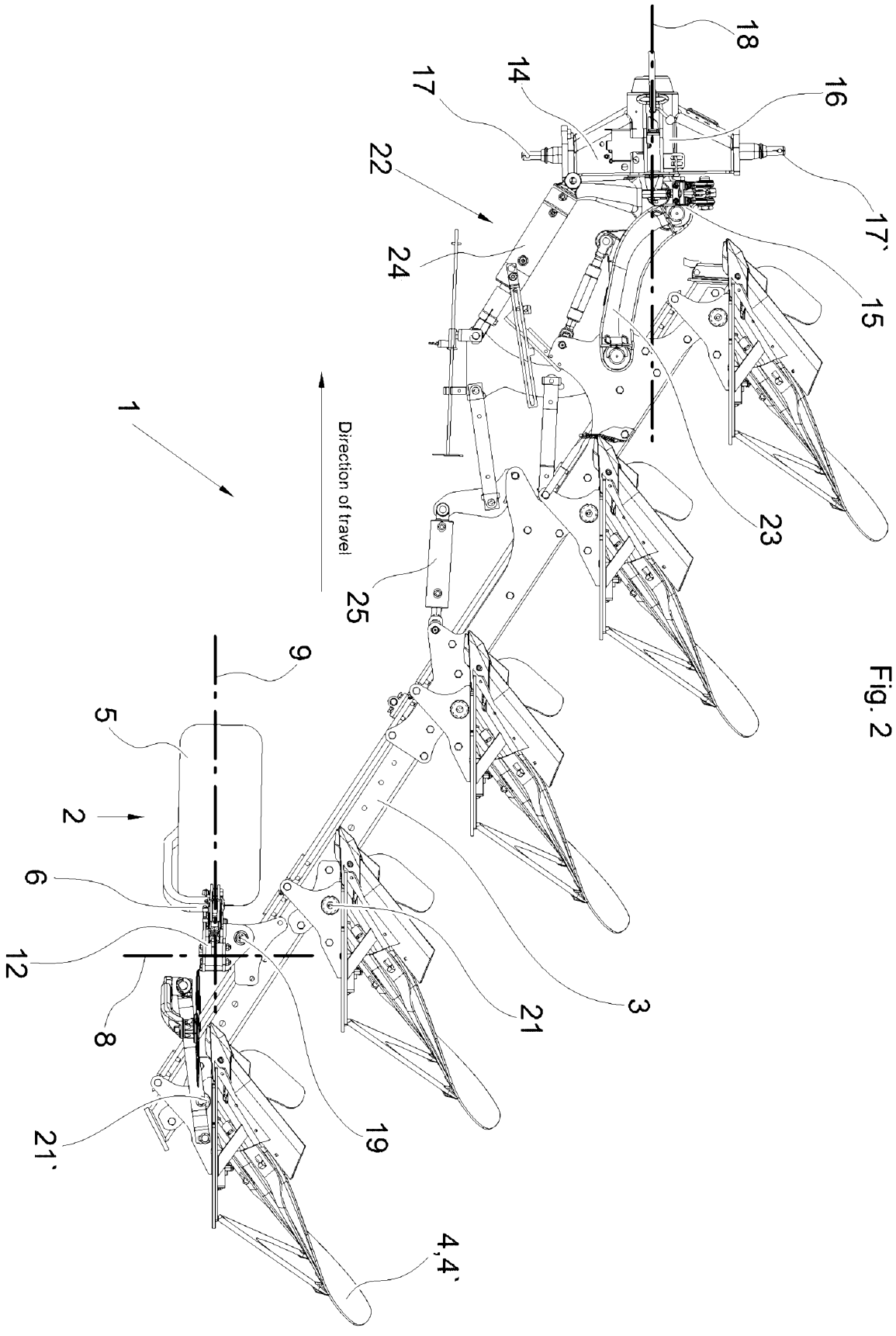
18
14
16
17
17`
22
24
15
23
25
1
Direction of travel
9
5
2
6
12
8
21
3
19
21`
4,4`

Fig. 2

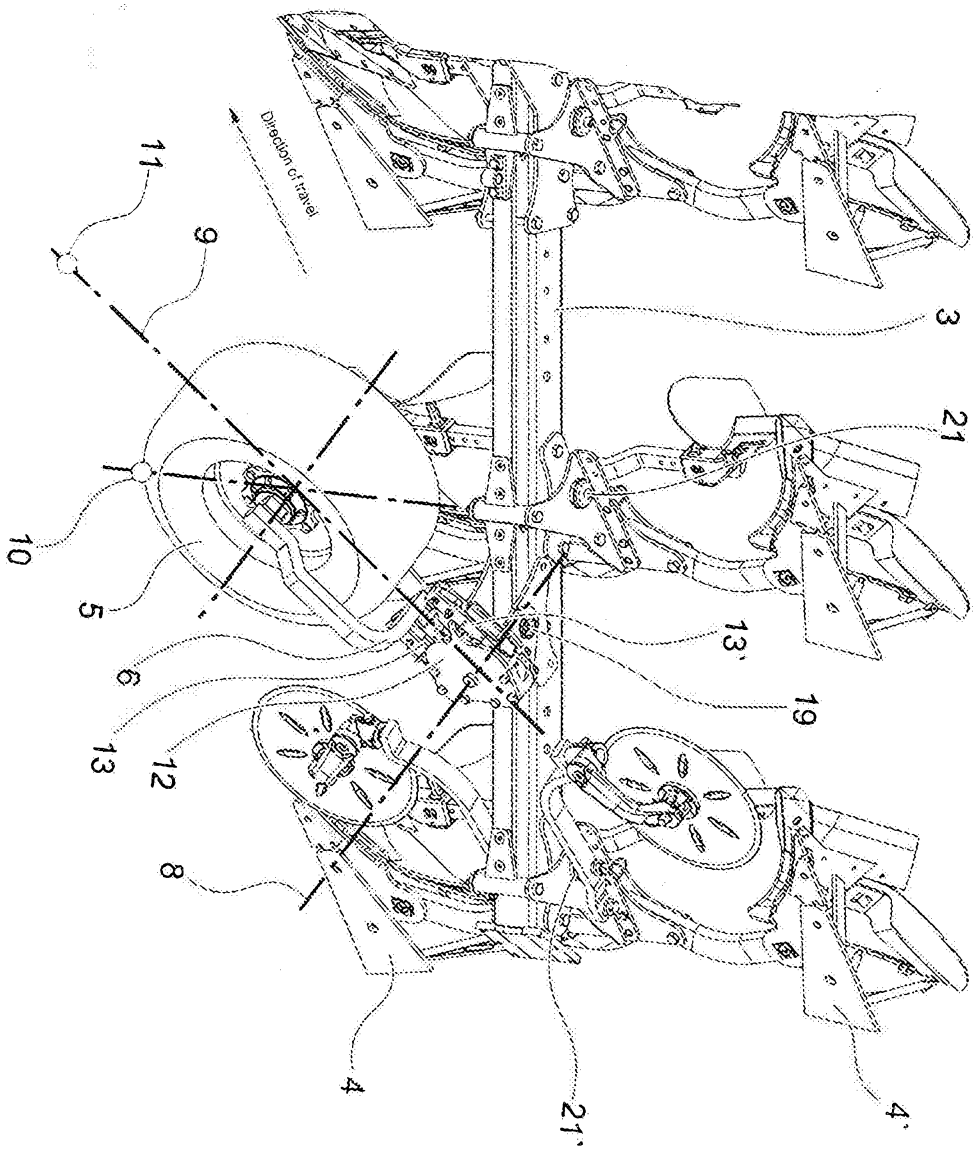

Fig. 3