(19) DANMARK

(10) **DK/EP 4091429 T3**

(12) Oversættelse af europæisk patentskrift

Patent- og Varemærkestyrelsen

(51) Int.Cl.: ***A 01 D 78/10 (2006.01)*** ***A 01 B 73/04 (2006.01)***

(45) Oversættelsen bekendtgjort den: **2024-11-18**

(80) Dato for Den Europæiske Patentmyndigheds bekendtgørelse om meddelelse af patentet: **2024-09-04**

(86) Europæisk ansøgning nr.: **22173525.1**

(86) Europæisk indleveringsdag: **2022-05-16**

(87) Den europæiske ansøgnings publiceringsdag: **2022-11-23**

(30) Prioritet: **2021-05-18 FR 2105155**

(84) Designerede stater: **AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR**

(73) Patenthaver: **Kuhn SAS, 4 impasse des Fabriques, 67700 Saverne, Frankrig**

(72) Opfinder: **KOEPPEL, Frédéric, , 67270 HOCHFELDEN, Frankrig**

(74) Fuldmægtig i Danmark: **Patrade A/S, Ceresbyen 75, 6., 8000 Århus C, Danmark**

(54) Benævnelse: **MULTI-SEGMENT HØVENDER**

(56) Fremdragne publikationer:
EP-A1- 0 534 127
EP-A1- 3 788 862
EP-B1- 0 951 818
EP-B1- 2 366 272
DE-U1- 9 111 676

Description

Title of the invention: Multi-segmented haymaking machine

[0001] The present invention relates to an agricultural machine moving along a direction of advance in use and comprising a chassis and two side units, each side unit being articulated to the chassis on either side of the chassis so as to be able to pivot about a first travel axis substantially parallel to the direction of advance. Each side unit comprises several rotors, each of which is driven in rotation about a rotation axis and supported by a support. The rotors of a side unit are articulated to each other about at least a second travel axis and a third travel axis substantially parallel to the direction of advance and about a substantially vertical orientation axis. Each side unit can adopt a deployed configuration of use in which the rotation axes of its rotors lie in the same plane, and a transport configuration in which these rotation axes are substantially horizontal.

[0002] Such a machine is known, for example, from the document EP0534127. Such a machine is also known from the document DE 9111676. On these machines, the articulation axes of the machine disclosed herein enable, in the transport configuration, a plane passing through the rotation axes of the third and fourth rotors to form a right angle with a plane passing through the rotation axes of the second and third rotors. A major drawback of this machine is its considerable height in the transport configuration. In addition, adding rotors to the side units of a machine according to the document EP0534127 would imply a considerable length in the transport configuration. Moreover, with a machine according to the document EP0534127 comprising more rotors per side unit, the stresses in the structure induced by the weight of the rotors would be particularly high in the transport configuration.

[0003] The main purpose of the present invention is to overcome the above-mentioned drawbacks, and to this end proposes, for a machine of the type indicated in the introduction, that each side unit comprises at least four rotors, that the orientation axis is located between the second rotation axis and the fourth rotation axis from the chassis, that so-called adjustable rotors can

pivot relative to the chassis about the orientation axis at an angle between 20° and 60°, and that each side unit comprises an inner part comprising the first rotor and the second rotor from the chassis and an outer part comprising at least the last two rotors from the chassis, the outer part being able to pivot between a position alongside and a position above the inner part seen in the direction of advance.

[0004] The invention also relates to a shifting method for a side unit of an agricultural machine of the type indicated above.

[0005] The invention will be better understood through the following description, which refers to preferred embodiments given as non-limiting examples and explained with reference to the attached schematic drawings, in which:

[0006] [Fig. 1],

[0007] [Fig. 2] and

[0008] [Fig. 3] partially show a top view, a rear view and a side elevation view, respectively, of an agricultural machine according to a first embodiment of the invention, in the deployed configuration, with the machine in Fig. 3 hitched to a tractor;

[0009] [Fig. 4] and

[0010] [Fig. 5] are partial top views, at a different scale, of segments and of the driveline of a side unit forming part of the machine in Figures 1 to 3, respectively in the deployed configuration of the said side unit (Figure 4) and after pivoting of the adjustable rotors about the orientation axis (Figure 5);

[0011] [Fig. 6A],

[0012] [Fig. 6B] and

[0013] [Fig. 6C] are schematic top views of a side unit of a machine according to a preferred embodiment, respectively in the deployed configuration(6A), after pivoting of the adjustable rotors about the orientation axis (6B) and after pivoting of the outer part above the inner part (6C);

[0014] [Fig. 7A],

[0015] [Fig. 7B] and

[0016] [Fig. 7C] are schematic top views of a side unit of an agricultural machine according to a first alternative embodiment of the invention, respectively in the deployed configuration (7A), after pivoting of the adjustable rotors about the orientation axis (7B) and after pivoting of the outer part above the inner part (7C);

[0017] [Fig. 8] is a partial top view of a machine according to the invention with a single side unit in a configuration such as shown in Figure 6B;

[0018] [Fig. 9A] and

[0019] [Fig. 9B] are respectively rear and top views of the machine shown in Figure 8 after pivoting of the outer part of the side unit above its inner part;

[0020] [Fig. 10A],

[0021] [Fig. 10B] and

[0022] [Fig. 10C] are respectively top, rear and side elevation views of the machine shown in Figures 8 and 9 in the transport configuration (fully folded configuration), and,

[0023] [Fig. 11] is a side view similar to Fig. 3 in which the signage shield is retracted.

[0024] Figures 1 to 3 and 6 to 11 all illustrate, at least in part, an agricultural machine (1) moving along a direction of advance (DA) in use and comprising a chassis (2) and two side units (G1, G2). Each side unit (G1, G2) is articulated on either side of the chassis (2) so as to able to pivot about a first travel axis (B1) that is substantially parallel to the direction of advance (DA).

[0025] Each side unit (G1, G2) comprises several rotors (R1, R2, R3, R4, R5). Each rotor (R1, R2, R3, R4, R5) is driven in rotation about a rotation axis (AR1, AR2, AR3, AR4, AR5) and supported by a support (5). The rotors (R1, R2, R3, R4, R5) of each side unit (G1, G2) are articulated to each other about at least a second travel axis (B2) and a third travel axis (B3), which are both substantially parallel to the direction of advance (DA) and about a substantially vertical orientation axis (AP) in the deployed configuration. Each side unit (G1, G2) can adopt a deployed configuration of use in which the rotation axes (AR1, AR2, AR3, AR4, AR5) of its rotors (R1, R2, R3, R4,

R5) lie in a same plane. Each side unit (G1, G2) can adopt a transport configuration in which these rotation axes (AR1, AR2, AR3, AR4, AR5) are substantially horizontal.

[0026] In accordance with the invention, each side unit (G1, G2) comprises at least four rotors (R1, R2, R3, R4, R5), making it possible to increase the working width and thus to work a bigger surface area on each pass or use of the machine (1), thus speeding up agricultural work. The width (see Figures 1 and 2) is to be considered horizontally and perpendicular to the direction of advance (DA). The machine (1) can also comprise two central rotors (RC) supported directly by the chassis (2). Thus, the agricultural machine (1) has at least ten rotors, namely at least eight (2x4) rotors on the said side units (G1, G2) and two central rotors (RC). In order to further increase the working width in the deployed configuration, without further complicating the machine (1) and while maintaining reduced dimensions in the transport configuration, each side unit (G1, G2) can advantageously comprise, as shown in Figures 1, 6A and 7A in particular, five rotors (R1, R2, R3, R4, R5). As shown in Figure 1, in the deployed configuration, each side unit (G1, G2) extends transversely, and preferably perpendicularly, to the direction of advance (DA).

[0027] Also in accordance with the invention, the orientation axis (AP) is located between the second rotation axis (AR2) and the fourth rotation axis (AR4) from the chassis (2). In addition, so-called adjustable rotors (R3, R4, R5) can pivot relative to the chassis (2) about the orientation axis (AP) at an angle between 20° and 60°. The adjustable rotors (R3, R4, R5) of a side unit (G1, G2) are therefore those that can pivot about the orientation axis (AP) relative to the chassis (2), respectively relative to the other rotors. The fact that the adjustable rotors (R3, R4, R5) can be pivoted about the orientation axis (AP) at an angle of at least 20° makes it possible to reduce the dimension of the side unit (G1, G2) in a direction perpendicular to the direction of advance (DA). The machine height in the transport configuration can therefore be reduced. As the pivoting angle of the adjustable rotors (R3, R4, R5) about the orientation axis (AP) is less than 60°, the size of a side unit (G1, G2) along the direction of advance (DA) in the transport

configuration is reduced. This results in a reduced length of the machine (1) in the transport configuration. Moreover, the greater the pivoting angle of the adjustable rotors (R3, R4, R5) about the orientation axis (AP), the greater the forces associated with the weight of the adjustable rotors (R3, R4, R5) in the transport configuration. With such an arrangement, the structure of the side unit (G1, G2) is less stressed.

[0028] Still according to the invention, each side unit (G1, G2) comprises an inner part (3) comprising the first rotor (R1) and the second rotor (R2) from the chassis (2) and an outer part (4) comprising at least the last two rotors (R3, R4, R5) from the chassis (2). In addition, each outer part (4) can pivot between a position next to (laterally outwards-deployed configuration) the inner part (3) and a position above (superimposed-folded transport configuration) the said inner part (3), at least seen in the direction of advance (DA). Moving the outer part (4) above the inner part (3) in this way makes it possible to further reduce the size of the side unit (G1, G2) in a horizontal direction perpendicular to the direction of advance (DA), resulting in a lower height in the transport configuration. If applicable, the fifth rotor (R5) is of course located in the outer part (4).

[0029] In this way, the invention enables the working width of the machine (1) to be considerable in the deployed configuration of use, while preserving reduced dimensions in the transport configuration. The space requirement in the transport configuration thus complies with the majority of current standards and regulations, and limits overhangs.

[0030] In order to avoid numerous iterations of the terms "from the chassis (2)", it is specified that each element with a sequence number is to be considered from the chassis (2). For example, the first rotor (R1) of a side unit (G1, G2) is located, in the deployed configuration, between the chassis (2) and the second rotor (R2) of the same side unit (G1, G2). The second rotor (R2) for its part is located between the first (R1) and third (R3) rotors of the same side unit (G1, G2) in the deployed configuration, and so on. The same applies to the rotation axes, travel axes and segments. Furthermore, in this

document, inner refers to the center of the machine (1), more precisely to its midplane (M), passing through the chassis (2).

[0031] As shown in Figures 1 and 2 in particular, the structure of each side unit (G1, G2) is formed by segments (S1, S2, S3, S4, S5) supporting the rotors (R1, R2, R3, R4, R5). The first segment (S1) of each side unit (G1, G2) is connected to the chassis (2) by the first travel axis (B1). Each side unit (G1, G2) can thus pivot relative to the chassis (2) about the said first travel axis (B1). The side unit (G1, G2), respectively the first segment (S1), could also be articulated to the chassis (2) by a ball joint allowing pivoting about the first travel axis (B1). Two rotors (R1, R2, R3, R4, R5) are said to be adjacent when their outer paths overlap, in the deployed configuration of use. In Figures 6 and 7, the rotors (R1, R2, R3, R4, R5) are represented by their respective outer paths. A segment (S1, S2, S3, S4, S5) is adjacent to another if its, respectively one of its, rotor(s) is adjacent to the, respectively to one of the, rotor(s) of the said other segment. Two adjacent segments (S1, S2, S3, S4, S5) are connected by at least one articulation, enabling them to pivot relative to each other with their respective rotor(s). In this way, two adjacent segments (S1, S2, S3, S4, S5) can be articulated by two travel axes (B2, B3, B4, B5), or even by one travel axis (B2, B3, B4, B5) and the orientation axis (AP).

[0032] In order to comply with the regulations of many countries, the machine (1) can optionally comprise two signage shields (25) visible from the rear of the machine (1) in the transport configuration, each signage shield being connected to the chassis (2) by a connecting structure (26).

[0033] A signage shield (25) is rigidly fastened to the outer part (4) of each side unit (G1, G2). In addition, this signage shield (25) is located at least partially above the respective outer part (4) in the deployed configuration. As each signage shield (25) is thus brought closer to the plane containing the rotation axes (AR1, AR2, AR3, AR4, AR5) of the corresponding side unit (G1, G2) in the deployed configuration, the connecting structure (26) is thus shortened. The overhang of the signage shields (25) is thus reduced and the connecting structure (26) is subjected to less stress. The latter can thus

be lightened and/or require less structural reinforcement, thus avoiding additional costs. As the length of the machine (1) in the deployed configuration is also reduced, its maneuverability is improved. Moreover, in this configuration there are no protruding elements at the rear of the rotors (R1, R2, R3, R4, R5), so they can be moved rearwards as close as possible to an obstacle such as a tree or fence. The entire field can thus be worked without any special maneuvers. The risk of damage to the signage shields (25) and/or the connecting structure (26) is also reduced, particularly when reversing. Finally, the rear of the machine (1) is more easily accessible, facilitating and securing maintenance at this level of the machine (1) in the deployed configuration, particularly on the central rotors (RC) supported by the chassis (2).

[0034] Figures 1 to 3 in particular show that a signage shield (25) is a crosshatched plate. Between the crosshatching, the stripes are preferably red and white. In addition, each signage shield (25) can also comprise a lighting system, preferably with high beams and flashing lights.

[0035] As can be seen from Figures 1 and 2, the signage shields (25) are rigidly fastened to the respective outer part (4) via the structure of the relevant side unit (G1, G2). In the preferred embodiment, each signage shield (25) is rigidly fastened to the corresponding last segment (S4, S5). The last segment (S4, S5) of a side unit (G1, G2) is the one furthest from the chassis (2) in the deployed configuration. Similarly, the last rotor (R4, R5) is the rotor (R1, R2, R3, R4, R5) of the side unit (G1, G2) considered furthest from the chassis (2) in the deployed configuration. In the preferred embodiment, the last rotor (R5) and the last segment (S5) are the fifth from the chassis (2) in the deployed configuration. If the side unit (G1, G2) has adjustable rotors (R3, R4, R5) as described above, the last segment (S4, S5) is the rearmost segment (S1, S2, S3, S4, S5) of the side unit (G1, G2) considered in the transport configuration. In this way, no rotor (R1, R2, R3, R4, R5) obstructs or hides, even partially, the signage shields (25) in this configuration. Figures 10 also show that, with this type of mounting, each signage shield (25) is positioned at a height permitted by a majority of standards in force.

[0036] As shown in Figures 1 and 2, the orientation axis (AP) is substantially vertical in the deployed configuration. In this configuration, the rotation axes (AR1, AR2, AR3, AR4, AR5) are lying in a plane substantially perpendicular to the direction of advance (DA) in top view. This plane is also substantially vertical. The travel axes (B1, B2, B3, B4, B5) are substantially parallel to the direction of advance (DA) in the deployed configuration. Pivoting about the travel axes (B1, B2, B3, B4, B5) and the orientation axis (AP) is done through actuators (V1, V2, V3, V4), preferably of the hydraulic cylinder type, that can be controlled from the tractor (10). Finally, it can be seen from Figures 1 and 2 that in the deployed configuration, the outer part (4) is in a position where it is next to the inner part (3) seen in the direction of advance (DA). In the deployed configuration, the outer part (4) is located laterally outside the respective inner part (3).

[0037] The invention preferably concerns a haymaking machine (1) of the tedder type in which each rotor (R1, R2, R3, R4, R5), and the central rotor (RC) if applicable, comprises arms, at the peripheral ends of which are attached tines. The latter make it possible to rake and throw towards the rear of the machine (1) a product such as grass lying on the ground (S), in order to accelerate drying of the said product. In the case of a tedder, the outer path of a rotor (R1, R2, R3, R4, R5) is the path formed by its outer tine as it rotates about the corresponding rotation axis (AR1, AR2, AR3, AR4, AR5). Each rotor (R1, R2, R3, R4, R5) is offset from the adjacent rotor(s) (R1, R2, R3, R4, R5), and from the adjacent central rotor (RC) if applicable, along its rotation axis (AR1, AR2, AR3, AR4, AR5). In the example shown, each rotor has six arms, each offset 30° relative to the adjacent rotor(s) (R1, R2, R3, R4, R5), and to the adjacent central rotor (RC) if applicable. In an alternative embodiment not shown, the machine (1) could be a mower in which each rotor (R1, R2, R3, R4, R5) would be equipped with blades which, when rotating, form an outer path centered on the respective rotation axis (AR1, AR2, AR3, AR4, AR5).

[0038] To ensure that the product is turned over as it is projected rearwards, and thus to obtain more evenly drying, the rotation axes (AR1, AR2, AR3, AR4, AR5) are preferably inclined slightly forwards. In this document,

"substantially vertical" refers to a direction forming an angle greater than 60° with a horizontal direction. In the preferred embodiment, each rotation axis (AR1, AR2, AR3, AR4, AR5) forms an angle between 5° and 25°, and more preferably between 10° and 20°, with the vertical, projected onto the midplane (M). In order to obtain a compact machine (1) in the transport configuration, the travel axes (B1, B2, B3, B4, B5) are substantially perpendicular to the rotation axes (AR1, AR2, AR3, AR4, AR5), projected onto the midplane (M). In this document, "substantially parallel" means that the two straight lines or directions indicated form an angle less than 30°. Thus, in the preferred embodiment, the travel axes (B1, B2, B3, B4, B5) form an angle with the direction of advance (DA) less than 30°, and more preferably less than 20° in the deployed configuration.

[0039] The machine (1) comprises a front-mounted hitching device (7). This is designed to be connected to a towing vehicle (10). It is preferably of the three-point type. In the transport configuration, the machine (1) is not in contact with the ground (S). This type of machine (1), towed by the tractor (10) in the transport configuration, is easier to maneuver.

[0040] A straight so-called coupling line (8) passing through the two lower pins of the hitching device (7) is oriented horizontally. The plane so-called midplane (M) is orthogonal to the straight coupling line (8) and parallel to the direction of advance(DA). This midplane (M) is also equidistant from the lower pins of the hitching device (7). Unless otherwise stated, any orientation indicated in this document is to be considered for a machine (1) in the deployed configuration, hitched to a towing vehicle (10), the tractor (10) and the machine (1) being arranged on a support element, respectively a horizontal and level ground (S). The direction of advance (DA) is oriented substantially horizontally.

[0041] The shifting of the machine (1) from its deployed configuration of use to its transport configuration is the same shifting for both side units (G1, G2). Preferably, when shifting, one side unit (G1) shifts with a slight time lag relative to the other side unit (G2) to prevent them from colliding. The segments (S1, S2, S3, S4, S5) of the two side units (G1, G2) are

substantially symmetrical with respect to the midplane (M), at least in the deployed and transport configurations of the machine (1). When using the machine (1), at least one side unit (G1, G2) is in the deployed configuration. When both side units (G1, G2) are in the deployed configuration, the machine (1) is in the deployed configuration. When both side units (G1, G2) are in the transport configuration, the machine (1) is in the transport configuration. The same applies to all configurations.

[0042] According to another advantageous feature of the invention, the outer part (4) of each side unit (G1, G2) is longer than its inner part (3). In this way, it is ensured that a specific height is not exceeded in the transport configuration. By pivoting the adjustable rotors (R3, R4, R5) about the rotation axis (AP), when shifting a side unit (G1, G2) from its deployed configuration of use to its transport configuration, the outer parts (4) do not collide with each other or with the chassis (2). Figures 10 also show that, with outer parts (4) longer than the inner parts (3), connecting structures (26) for the signage shields (25) which would be connected to the chassis (2) would also be particularly long, and would present a complex shape to produce.

[0043] As shown in Figure 1 in particular, each side unit (G1, G2) can comprise a side protection (9) extending further from the chassis (2) than the last rotor (R4, R5) from the chassis (2). In the case of a side unit (G1, G2) with four rotors (R1, R2, R3, R4), the outer part (4) is therefore longer than the inner part (3) due to the side protection (9).

[0044] Since each signage shield (25) and its connecting structure (26) are pivoted with the respective side unit (G1, G2), respectively with the outer part (4) to which it is rigidly fastened, there is no need for the signage shield (25) and its connecting structure (26) to be located outside the paths of travel of the side units (G1, G2) when shifting between the deployed and transport configurations. According to an interesting feature, each signage shield (25) is located closer to the chassis (2) than the corresponding side protection (9) in the deployed configuration. In this way, in the deployed configuration, the width of the machine (1) is not increased. Furthermore, in the transport

configuration, each signage shield (25) is located closer to the chassis (2) than the rear end of the machine (1). The machine (1) thus occupies less space on the ground (S) in transport configuration. Preferably, each signage shield (25) is located, in the deployed configuration, closer to the chassis (2) than to the outer path of the rotor (R4, R5) of the segment (S4, S5) to which it is rigidly fastened, so that in the transport configuration, the machine (1) is shorter, thus improving its maneuverability. As authorized by most standards, each signage shield (25) is located less than one meter before the rear end of the machine (1).

[0045] When shifting a side unit (G1, G2) between the deployed configuration and the transport configuration, its adjustable rotors (R3, R4, R5) are pivoted about the orientation axis (AP) by an orientation angle (27), and in the deployed configuration, the signage shield (25) forms an angle with the plane passing through the rotation axes (AR1, AR2, AR3, AR4, AR5), seen along one of the rotation axes (AR1, AR2, AR3, AR4, AR5), whose value is substantially equal to the value of the orientation angle (27). Consequently, the signage shield (25) is oriented at least substantially parallel to the straight coupling line (8) in the transport configuration, and is therefore particularly visible from the rear of the machine (1).

[0046] According to another interesting feature, the adjustable rotors (R3, R4, R5) can pivot about the orientation axis (AP) at an angle of approximately 45° relative to the chassis (2). When each side unit (G1, G2) comprises five rotors (R1, R2, R3, R4, R5), this feature offers a good compromise between the length of the machine (1) in the direction of advance (DA) and its height in the transport configuration, while significantly increasing its working width in the deployed configuration.

[0047] The orientation of the signage shield (25) in the transport configuration and in side view is dependent on the tractor (10). In fact, to avoid any interaction between the machine (1) and the ground (S), the machine (1) is pivoted upwards relative to the tractor (10), enabling it to move more quickly without having to equip the machine (1) accordingly. As shown in Figure 1, the signage shield (25) forms an angle between 5° and 45° relative to the

direction of advance (DA) and in side view. In this way, the signage shield (25) is oriented substantially perpendicular to the direction of advance (DA) in the transport configuration, improving its visibility from the rear of the machine (1) in the transport configuration.

[0048] According to a further interesting feature, each side unit (G1, G2) can pivot about the respective first travel axis (B1) in the same pivoting direction as its outer part (4) relative to the respective inner part (3). Preferably, for shifting between the deployed configuration of use and the transport configuration, each side unit (G1, G2) is pivoted approximately 90° about the respective travel axis (B1). This pivoting makes it possible to bring the respective side unit (G1, G2) into the transport position. It is through this pivoting of the side units (G1, G2) that the rotation axes (AR1, AR2, AR3, AR4, AR5) are oriented substantially horizontally in the transport configuration. In this configuration, the rotation axes (AR1, AR2, AR3, AR4, AR5) are also oriented perpendicular to the direction of advance (DA). As can be seen from Figure 10B, in the transport configuration of the side units (G1, G2), the outer parts (4) are positioned at least partially between the inner parts (3) seen in the direction of advance (DA). This feature makes it possible to reduce the width of the machine (1) and to shift its center of gravity forward, ensuring greater stability of the machine (1) in the transport configuration. Figure 10C also shows that, in the transport configuration of a side unit (G1, G2), the plane passing through the first (AR1) and second (AR2) rotation axes forms an angle of approximately 45° downwards and to the rear with the plane passing through the third (AR3) and fourth (AR4) rotation axes. In this configuration, the outer part (4) rests on the chassis (2), advantageously making is possible to relieve the structure of the respective side unit. Preferably, each side unit (G1, G2) is pivoted approximately 90° about the respective travel axis (B1) once pivoting of its outer part (4) relative to the respective inner part (3) has been completed.

[0049] In accordance with the preferred embodiment shown in Figures 1 to 3, 6 and 8 to 10, the orientation axis (AP) is located between the third rotation axis (AR3) and the fourth rotation axis (AR4) from the chassis (2) in the deployed configuration. With such an arrangement of the orientation axis

(AP), the number of adjustable rotors (R4, R5) is reduced (Figures 6), thus limiting the effort required to pivot them. The adjustable rotors (R4, R5) are therefore the last two rotors (R4, R5) in the side unit (G1, G2) considered. In this embodiment, the center of gravity of each side unit (G1, G2) is further lowered, making the machine (1) more stable in the transport configuration.

[0050] The outer part (4) can be pivoted about the second (B2) or third (B3) travel axis by an angle greater than 150°. In the preferred embodiment shown in Figures 6, the outer part (4) is pivoted about the third travel axis (B3) by an angle of approximately 160°. Once this pivoting is complete (Figures 6B, 7B and 9), the outer part (4) occupies the position in which it is above the respective inner part (3) seen in the direction of advance (DA). As can be seen from Figures 6 and 7, each outer part (4) comprises the third rotor (R3) and fourth rotor (R4) and, if applicable, the fifth rotor (R5) of the respective side unit (G1, G2) from the chassis (2).

[0051] In the preferred embodiment, the orientation axis (AP) is neither concurrent nor coincident with the rotation axes (AR1, AR2, AR3, AR4, AR5). The height of the machine (1) in the transport configuration can thus be reduced. More precisely still, the orientation axis (AP) is located between the third rotation axis (AR3) and the fourth travel axis (B4). Preferably, the orientation axis (AP) is not concurrent with any travel axis (B1, B2, B3, B4, B5). Compared with an embodiment in which the orientation axis (AP) and one of the travel axes (B2, B3, B4) are concurrent, such an embodiment leaves more room to install the actuators (V1, V2, V3, V4). In addition, these actuators thus experience less angle variation, making it possible to use standard ball joint articulations to attach them to the structure.

[0052] As shown in Figures 6 and 7, pivoting the adjustable rotors (R3, R4, R5) about the orientation axis (AP) can take place towards the front or the rear. In a first variant embodiment shown in Figures 7, the adjustable rotors (R3, R4, R5) can pivot forwards relative to the chassis (2) about the orientation axis (AP) which is located between the second (AR2) and the third (AR3) rotation axes. In this variant, the outer part (4) contains all the adjustable rotors (R3, R4, R5). According to this first variant, the stroke of the

orientation actuator (V3) enabling pivoting about the orientation axis (AP) must be greater so that the machine (1) can occupy an edge tedding configuration. Indeed, to reach this configuration, the adjustable rotors (R3, R4, R5) must be pivoted about the orientation axis (AP) in the opposite direction to that for shifting from the deployed configuration to the transport configuration.

[0053] According to an advantageous feature, at least one side unit (G1, G2) can also be in an edge tedding configuration in which the adjustable rotors (R3, R4, R5) are pivoted backwards about the orientation axis (AP) by approximately 20° from the deployed configuration of the side unit (G1, G2) considered. The edge tedding configuration makes it possible to prevent product projection outside an edge (11) as the side unit (G1, G2) moves along the said edge (11). The edge (11) is, for example, the edge of the field.

[0054] By means of the verticality of the orientation axis (AP), the supports (5) of the adjustable rotors (R3, R4, R5) remain in contact with the ground (S) even after having been pivoted 20° about the orientation axis (AP). The closer the orientation axis (AP) is to the vertical, the better the inclinations of the travel axes (B1, B2, B3, B4, B5) and the rotation axes (AR1, AR2, AR3, AR4, AR5) will be preserved in the edge tedding configuration. In the preferred embodiment, the orientation axis (AP) thus forms an angle greater than 75°, and preferably greater than 80°, with the horizontal. In this configuration, the angular sectors of travel of the adjustable rotors (R3, R4, R5) about the corresponding travel axes (B3, B4, B5) are thus substantially the same as those in the deployed configuration, so that in the edge tedding configuration, neither the raking quality nor the plant cover is damaged.

[0055] As shown in Figure 2, each support (5) can be formed by a roller or a freewheel. The rolling axes of these rollers are substantially horizontal and perpendicular to the direction of advance (DA) in the deployed configuration. To ensure that the roller axes remain perpendicular to the direction of advance (DA) in the edge tedding configuration, the rollers can be mounted so as to pivot about a substantially vertical axis relative to their respective segment (S1, S2, S3, S4, S5). The support (5) is preferably in contact with

the ground (S) in the deployed configuration. Each support (5) could also be formed by a skid sliding over the ground (S). Each support (5) can also be slightly off-centered relative to the corresponding rotation axis (AR1, AR2, AR3, AR4, AR5).

[0056] According to a second not shown variant embodiment, each side unit (G1, G2) comprises a first segment (S1) from the chassis (2) supporting the first (R1) and second rotors (R2), and a second segment (S2) supporting the third (R3) and fourth rotors (R4). In this variant, the first segment (S1) is connected to the second segment (S2) by the second travel axis (B2) and the third travel axis (B3). In this variant, the rotors of a side unit are articulated to each other only about the second and third travel axes (B2, B3). A drawback of such an embodiment, in which two adjacent rotors (R1, R2, R3, R4, R5) are not articulated along an axis parallel to the direction of advance (DA), is that the segments are less well adapted to the unevenness of the ground (S) which degrades the raking quality and/or causes damage to the plant cover.

[0057] In accordance with a preferred embodiment of the invention, each rotor (R1, R2, R3, R4, R5) is supported by a segment (S1, S2, S3, S4, S5) of its own. Each rotor (R1, R2, R3, R4, R5) is then articulated to the adjacent rotor(s) (R1, R2, R3, R4, R5) by a corresponding travel axis (B2, B3, B4, B5). In the deployed configuration, pivoting about the travel axes (B1, B2, B3, B4, B5) is unrestricted, allowing the segments (S1, S2, S3, S4, S5) to adapt properly to the ground (S). Each rotor (R1,R2, R3, R4, R5) can thus pivot relative to its adjacent rotor(s) (R1,R2, R3, R4, R5) about the corresponding travel axis (B1, B2, B3, B4, B5) by a certain angle of travel. Each side unit (G1, G2) thus follows the irregularities of the ground (S) more closely, resulting in better raking quality while preserving the plant cover. In the transport configuration, at least some, and preferably all, pivoting about the travel axes (B1, B2, B3, B4, B5) is blocked, to avoid any risk of breakage or injury.

[0058] As shown in Figures 4 and 5 by way of example, the segments (S1, S2, S3, S4, S5) of each side unit (G1, G2) are fitted with motion transmission

shaft sections (PA, PB, PC) for the rotors (R1, R2, R3, R4, R5), guided in rotation by bearings (6) and cooperatively forming together a driveline for the side unit (G1, G2) considered.

[0059] The kinematic connection between the various shaft sections (PA, PB, PC) at the travel axes (B1, B2, B3, B4, B5) can be achieved, for example, by a double cardan joint (not shown). As shown in Figure 5, these connections are preferably achieved by complementary means (C1, C2) of a finger drive. The complementary means (C1, C2) are mutually meshing in the deployed configuration. By providing a specific distance between the travel axis (B1, B2, B3, B4, B5) or the orientation axis (AP) and the driveline axis, the complementary means (C1, C2) also engage when the shaft sections (PA, PB, PC) are pivoted about the said axis, as shown in Figure 5. In this way, the rotors (R1, R2, R3, R4, R5) retain their orientation about their respective rotation axis in all configurations, enabling uninterrupted control of their position, in particular locking in position in the case of non-driving.

[0060] In accordance with another interesting feature, the orientation axis (AP) is not concurrent with the axis of the shaft sections (PA, PB, PC) in the deployed configuration. The complementary means (C1, C2) of a finger drive advantageously allow at least one of the two shaft sections (PA, PB, PC) to slide relative to the other without being uncoupled. The use of a double cardan joint, for its part, would require at least one of the two shaft sections (PA, PB, PC) to slide relative to the other in order to allow pivoting about the axis (AP). The shaft sections (PA, PB, PC) thus do not need to be telescopic, avoiding frequent greasing operations and additional costs. In addition, the telescopic drive shaft sections do not usually allow long stroke distances, particularly with a drive shaft section (PB) as short as that extending between the orientation axis (AP) and the fourth travel axis (B4).

[0061] The pivot (12) of the orientation axis (AP) is carried out across the segment (S1, S2, S3, S4, S5) concerned, namely the third segment (S3) in the preferred embodiment. In this way, it is guided in rotation over most of

its height, and preferably over its entire height, allowing it to better withstand stresses and resulting in a longer service life.

[0062] In Figures 1 to 3, each signage shield (25) is connected to the corresponding side unit (G1, G2) by a respective connecting structure (26). The connecting structure (26) is made of a tube, preferably with a circular cross-section. As shown, the connecting structure (26) comprises three straight sections (30, 31, 32). A first section (30) is oriented substantially horizontally in the deployed configuration. This first section (30) is preferably parallel to the last segment (S4, S5) to which the signage shield (25), respectively its connecting structure (26), is rigidly fastened. The connecting structure (26) also has a second section (31) which is oriented substantially vertically in the deployed configuration, at least in side view. This second section (31) may have a slight inclination from vertical in the deployed configuration, seen in the direction of advance (DA). Finally, the connecting structure (26) has a third section (32) oriented, in the deployed configuration, transversely to the direction of advance (DA), and preferably substantially horizontally. As can be seen from Figure 1, the third section (32) preferably forms an angle of approximately 45° with the direction of advance (DA), in top view and in the deployed configuration. The signage shield (25) is immutably rigidly fastened to the respective connecting structure (26). Figure 11 in particular shows that the signage shield (25) is rigidly fastened to the second section (31) and the third section (32). The connecting structure (26) is rigidly fastened to the last segment (S4, S5) via the first section (30).

[0063] As shown in Figures 3 and 11, each signage shield (25) is optionally movable relative to the segment (S1, S2, S3, S4, S5) to which it is rigidly fastened. In the preferred embodiment, each signage shield (25) can be pivoted relative to the last corresponding segment (S4, S5) about a so-called clearing axis (29) oriented transversely to the direction of advance (DA) in the deployed configuration of use, advantageously enabling the signage shield (25) to be retracted in the event of contact with an obstacle when the machine (1) advances. More preferably, the clearing axis (29) is substantially parallel to the last segment (S4, S5) to which the signage shield

(25) is rigidly fastened, advantageously simplifying its connecting structure (26). In the deployed configuration of use, the clearing axis (29) is thus substantially horizontal, so that the height of a side unit (G1, G2) can be reduced without thereby increasing its width. Preferably, each signage shield (25) can pivot about the clearing axis (29) by an angle of at least 30°, and more preferably at least 40°. As can be seen in Figure 11, in the retracted position of the signage shield (25), the respective side unit (G1, G2) has a reduced height.

[0064] As shown in Figures 1 and 2, the entirety of each signage shield (25) and its connecting structure (26) is located above the corresponding outer part (4) in the deployed configuration. More precisely, the entirety of each signage shield (25) and its connecting structure (26) is located within the outer path of the rotor (R1, R2, R3, R4, R5) of the segment (S1, S2, S3, S4, S5) to which the signage shield (25) is rigidly fastened, in projection along the rotation axis of the said rotor (R1, R2, R3, R4, R5), reducing the length of the connecting structure (26).

[0065] The invention also relates to a shifting method for a side unit (G1, G2) of an agricultural machine (1) as described above

[0066] More precisely, the invention relates to a shifting method for a side unit (G1, G2) of an agricultural machine (1) moving along a direction of advance (DA) in use and comprising a chassis (2) and two side units (G1, G2), each side unit (G1, G2) being articulated on either side of the chassis (2) so as to be able to pivot about a respective first travel axis (B1) substantially parallel to the direction of advance (DA) and comprising at least four rotors (R1, R2, R3, R4, R5), each rotor (R1, R2, R3, R4, R5) being driven in rotation about a rotation axis (AR1, AR2, AR3, AR4, AR5) and supported by a support (5), the rotors (R1, R2, R3, R4, R5) of each side unit (G1, G2) being articulated to each other about at least a second travel axis (B2) and a third travel axis (B3) substantially parallel to the direction of advance (DA) and about a substantially vertical orientation axis (AP) located between the second rotation axis (AR2) and the fourth rotation axis (AR4) from the chassis (2).

[0067] This method enables shifting the side unit (G1, G2) considered from a deployed configuration of use, in which the rotation axes (AR1, AR2, AR3, AR4, AR5) of its rotors (R1, R2, R3, R4, R5) lie in the same plane, to a transport configuration in which these rotation axes (AR1, AR2, AR3, AR4, AR5) are substantially horizontal.

[0068] This process is characterized in that it consists in:

[0069] -i) pivoting the adjustable rotors (R3, R4, R5) about their respective orientation axis (AP) by an angle between 20° and 60°,

[0070] -ii) pivoting an outer part (4) comprising the third rotor (R3) and fourth rotor (R4) above, seen in the direction of advance (DA), an inner part (3) comprising the first rotor (R1) and second rotor (R2),

[0071] -iii) pivoting all rotors (R1, R2, R3, R4, R5) about the corresponding first travel axis (B1) in the same pivoting direction as the respective outer part (4) until their rotation axes (AR1, AR2, AR3, AR4, AR5) are oriented substantially horizontally and perpendicularly to the direction of advance (DA).

[0072] According to a first variant, the above steps are carried out chronologically, i.e. successively in the order they are stated.

[0073] According to a second variant, steps i) and ii) overlap at least partially in time, or are carried out simultaneously. In this latter case, however, pivoting 20° for edge tedding is only possible with an additional control when shifting from the deployed configuration to the transport configuration.

[0074] Shifting from the transport configuration to the deployed configuration is carried out by performing the reverse steps in reverse order.

[0075] Obviously, the invention is not limited to the embodiments described and shown in the attached drawings. Modifications remain possible, in particular as regards the composition of the various elements or the substitution by technical equivalents without departing from the scope of protection of the invention defined by the independent claims 1 and 9.

Patentkrav

1. Landbrugsmaskine (1), der bevæger sig i en fremføringsretning (DA) under brug og omfatter et chassis (2) og to sidegrupper (G1, G2), hvor hver sidegruppe (G1, G2) er leddelt på hver side af chassiset (2) for at kunne dreje rundt om en første bevægelsesakse (B1) i det væsentlige parallelt med fremføringsretningen (DA) og omfatter flere rotorer (R1, R2, R3, R4, R5), hvor hver rotor (R1, R2, R3, R4, R5) roteres omkring en rotationsakse (AR1, AR2, AR3, AR4, AR5) og understøttes af en støtte (5), idet rotorerne (R1, R2, R3, R4, R5) af hver sidegruppe (G1, G2) er leddelt med hinanden omkring mindst en anden bevægelsesakse (B2) og en tredje bevægelsesakse (B3), der i det væsentlige er parallelle med fremføringsretningen (DA) og omkring en i det væsentlige lodret orienteringsakse (AP), hvor hver sidegruppe (G1, G2) er i stand til at indtage en udfoldet brugskonfiguration, hvor rotationsakserne (AR1, AR2, AR3, AR4, AR5) for dens rotorer (R1, R2, R3, R4, R5) ligger i det samme plan og en transportkonfiguration, hvor disse rotationsakser (AR1, AR2, AR3, AR4, AR5) er i det væsentlige vandrette, idet hver sidegruppe (G1, G2) omfatter mindst fire rotorer (R1, R2, R3, R4, R5), orienteringsaksen (AP) er placeret mellem den anden rotationsakse (AR2) og den fjerde rotationsakse (AR4) fra chassiset (2), såkaldte indstillelige rotorer (R3, R4, R5) kan dreje i forhold til chassiset (2) omkring orienteringsaksen (AP) i en vinkel på mellem 20° og 60°, og ved at hver sidegruppe (G1, G2) omfatter en indre del (3), der omfatter den første rotor (R1) og den anden rotor (R2) fra rammen (2) og en ydre del (4), der omfatter mindst de to sidste rotorer (R3, R4, R5) fra chassiset (2),
maskine (1) kendetegnet ved, at den ydre del (4) kan dreje mellem en position ved siden af og en position over den indre del (3) set i fremføringsretningen (DA).

2. Landbrugsmaskine (1) ifølge krav 1, kendetegnet ved, at den ydre del (4) af hver sidegruppe (G1, G2) er længere end dens indre del (3).

3. Landbrugsmaskine (1) ifølge krav 1 eller 2, kendetegnet ved, at hver sidegruppe (G1, G2) omfatter fem rotorer (R1, R2, R3, R4, R5), og ved at de indstillelige rotorer (R3, R4, R5) kan dreje rundt om orienteringsaksen (AP) i en vinkel på ca. 45° i forhold til chassiset (2).

4. Landbrugsmaskine (1) ifølge et af kravene 1 til 3, kendetegnet ved, at hver sidegruppe (G1, G2) kan dreje rundt om den respektive første bevægelsesakse (B1) i samme drejeretning som dens ydre del (4) i forhold til den respektive indre

del (3).

5. Landbrugsmaskine (1) ifølge et af kravene 1 til 4, kendetegnet ved, at orienteringsaksen (AP) er placeret mellem den tredje rotationsakse (AR3) og den fjerde omdrejningsakse (AR4) fra chassiset (2) i udfoldet konfiguration.

6. Landbrugsmaskine (1) ifølge et af kravene 1 til 5, kendetegnet ved, at hver rotor (R1, R2, R3, R4, R5) er ledforbundet med den eller de tilstødende rotor(er) (R1, R2, R3, R4, R5) ved en bevægelsesakse (B2, B3, B4, B5).

7. Landbrugsmaskine (1) ifølge et hvilket som helst af kravene 1 til 6, kendetegnet ved, at orienteringsaksen (AP) hverken er sammenfaldende eller konvergerende med rotationsakserne (AR1, AR2, AR3, AR4, AR5) i udfoldet konfiguration.

8. Landbrugsmaskine (1) ifølge et hvilket som helst af kravene 1 til 7, kendetegnet ved, at mindst en sidegruppe (G1, G2) kan optage en kantbearbejdningskonfiguration, hvor de indstillelige rotorer (R3, R4, R5) er drejet bagud omkring orienteringsaksen (AP) med ca. 20° gående ud fra den udfoldede konfiguration af den pågældende laterale gruppe (G1, G2).

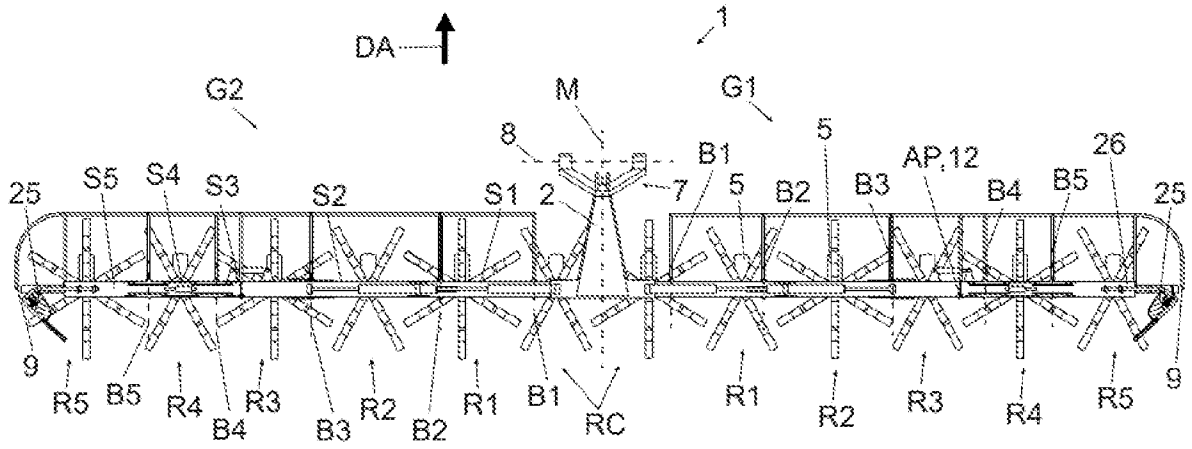
9. Fremgangsmåde til at transponere en sidegruppe (G1, G2) af en landbrugsmaskine (1), der bevæger sig i en fremføringsretning (DA) under brug og omfatter et chassis (2) og to sidegrupper (G1, G2), hver sidegruppe (G1, G2) er leddelt på hver side af chassiset (2) for at kunne dreje rundt om en første respektiv bevægelsesakse (B1) i det væsentlige parallel med fremføringsretningen (DA) og som omfatter mindst fire rotorer (R1, R2, R3, R4, R5), idet hver rotor (R1, R2, R3, R4, R5) roteres omkring en rotationsakse (AR1, AR2, AR3, AR4, AR5) og understøttes af en støtte (5), idet rotorerne (R1, R2, R3, R4, R5) i hver sidegruppe (G1, G2) er leddelt med hinanden omkring mindst en anden bevægelsesakse (B2) og en tredje bevægelsesakse (B3), der er i det væsentlige parallelle med fremføringsretningen (DA), og omkring en orienteringsakse (AP) i det væsentlige lodret og placeret mellem den anden rotationsakse (AR2) og den fjerde rotationsakse (AR4) fra chassiset (2),
hvor nævnte metode gør det muligt at transponere den pågældende sidegruppe (G1, G2) fra en udfoldet brugskonfiguration, hvor rotationsakserne (AR1, AR2, AR3, AR4, AR5) af dens rotorer (R1, R2, R3, R4, R5) er inkluderet i det samme plan mod en transportkonfiguration, hvor disse rotationsakser (AR1, AR2, AR3, AR4, AR5) er i det væsentlige vandrette, idet fremgangsmåden omfatter et trin, der består i at dreje alle rotorerne (R1, R2, R3, R4, R5) rundt om den tilsvarende første

bevægelsesakse (B1) i samme drejeretning som den respektive ydre del (4), indtil deres rotationsakser (AR1, AR2, AR3, AR4, AR5) er orienteret i det væsentlige vandret og vinkelret på fremføringsretningen (DA), metode kendetegnet ved, at den består af at:

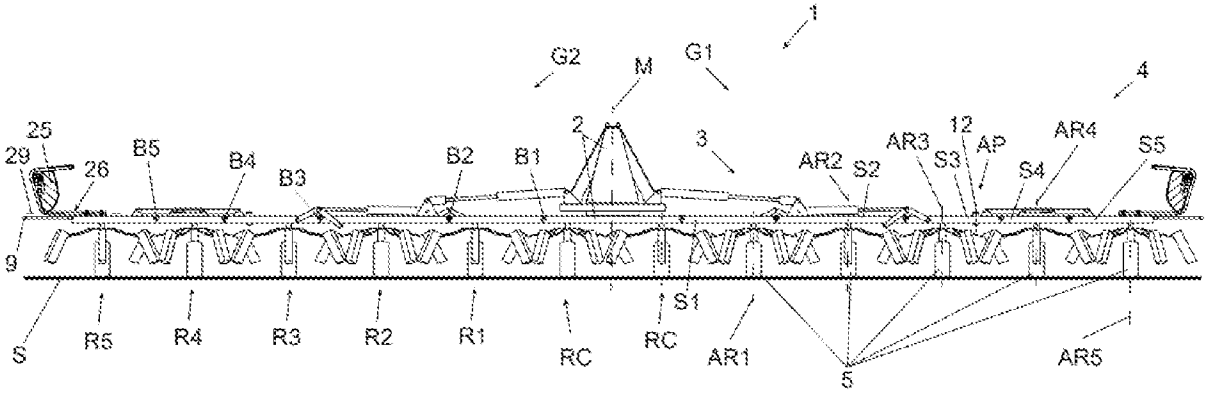
- i) dreje såkaldte indstillelige rotorer (R3, R4, R5) i forhold til chassiset (2) omkring orienteringsaksen (AP) i en vinkel mellem 20° og 60°,
- ii) dreje en ydre del (4) af den pågældende sidegruppe (G1, G2), omfattende den tredje rotor (R3) og den fjerde rotor (R4), set i fremføringsretningen (DA), oven over en indre del (3) af denne sidegruppe, omfattende den første rotor (R1) og den anden rotor (R2).

10. Fremgangsmåde ifølge krav 9, kendetegnet ved, at trin i) og ii) overlapper i det mindste delvist i tid eller endda udføres samtidigt.

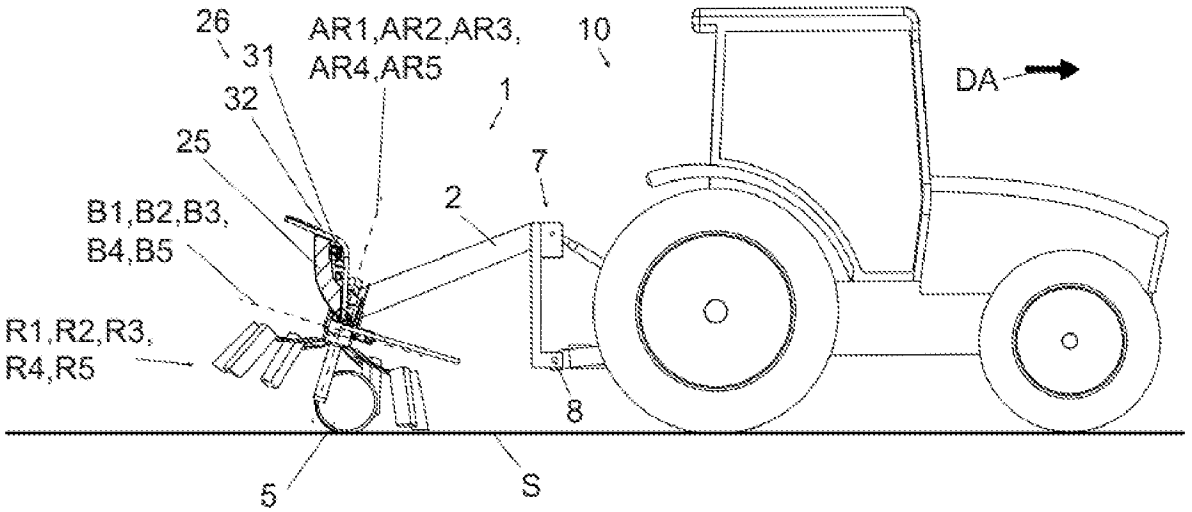
[Fig. 1]



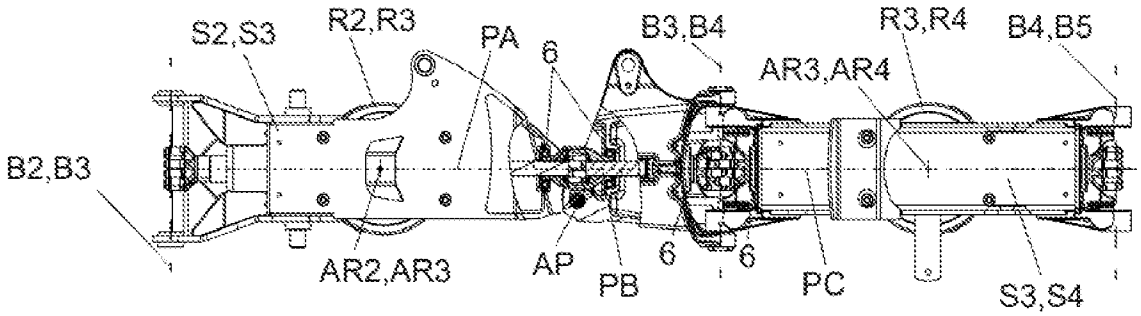
[Fig. 2]



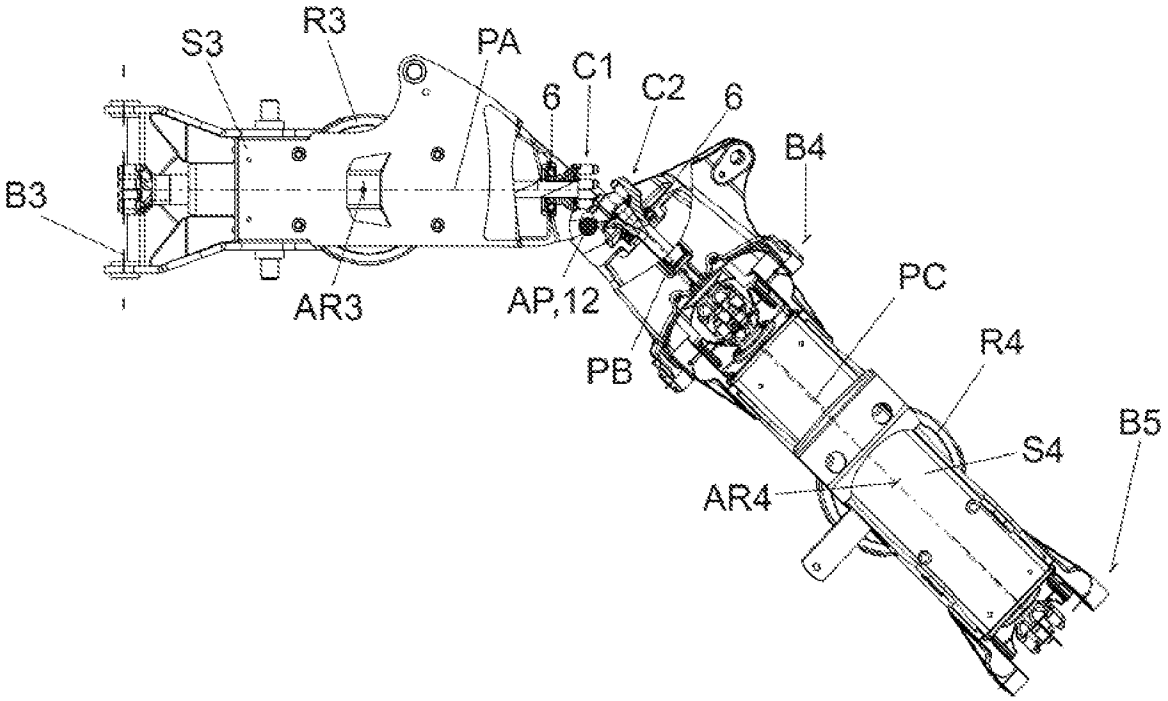
[Fig. 3]



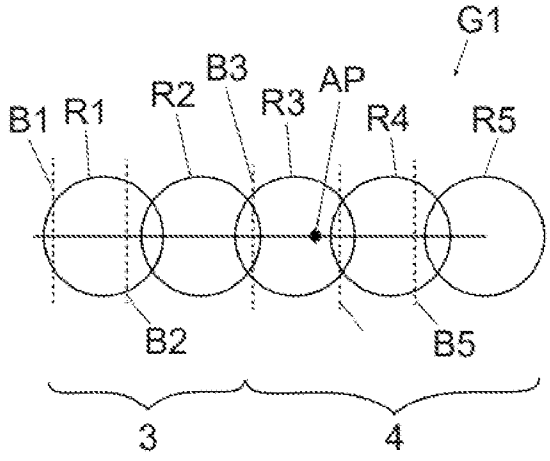
[Fig. 4]



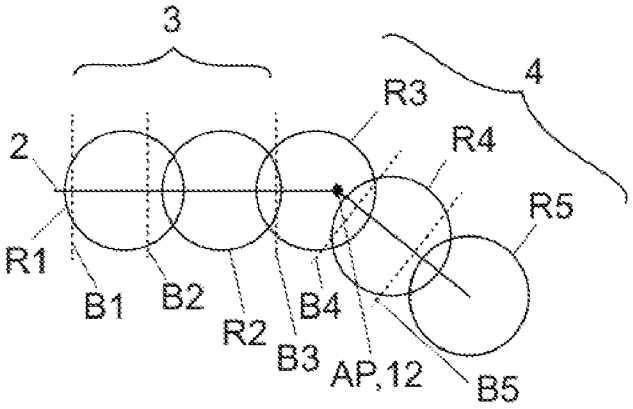
[Fig. 5]



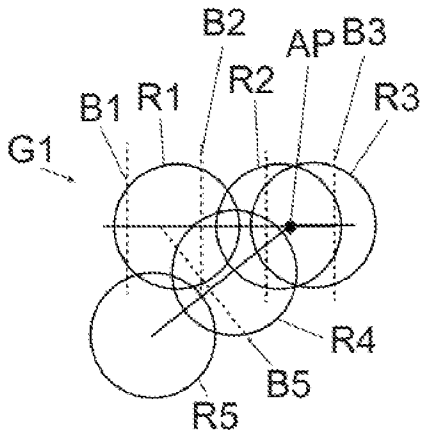
[Fig. 6A]



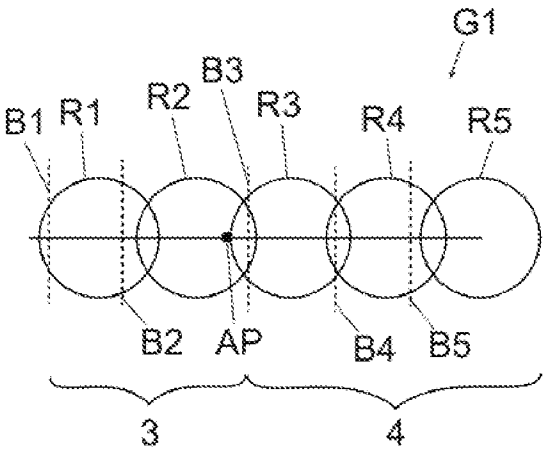
[Fig. 6B]



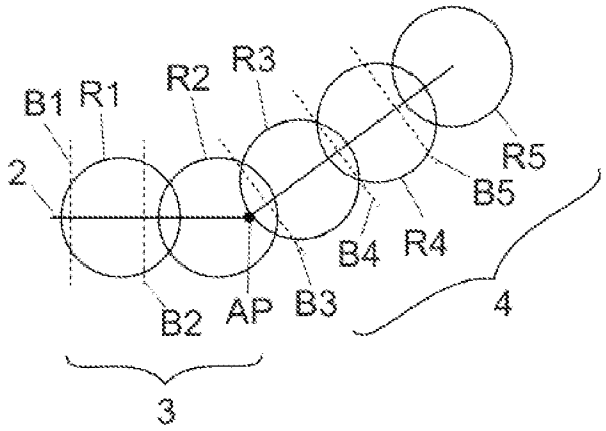
[Fig. 6C]



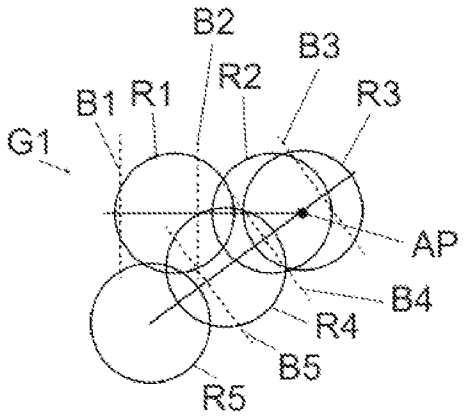
[Fig. 7A]



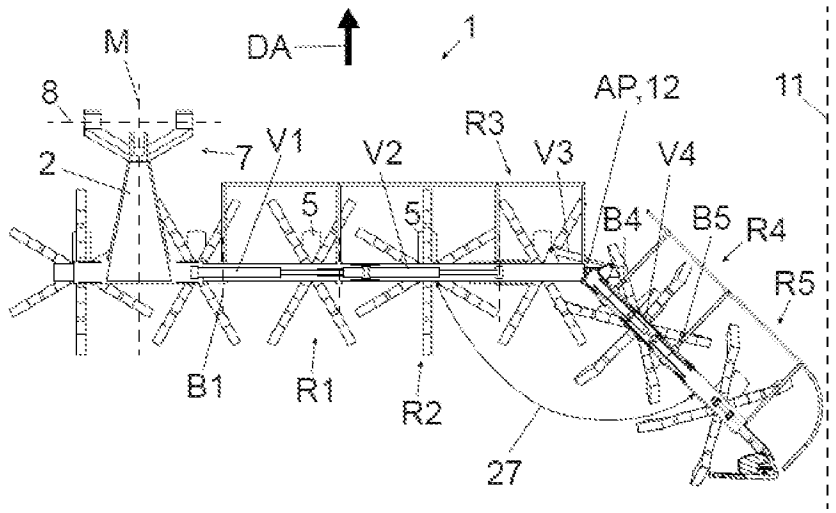
[Fig. 7B]



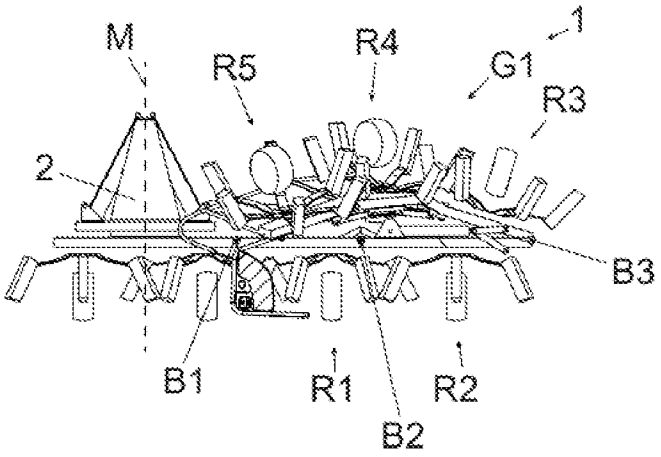
[Fig. 7C]



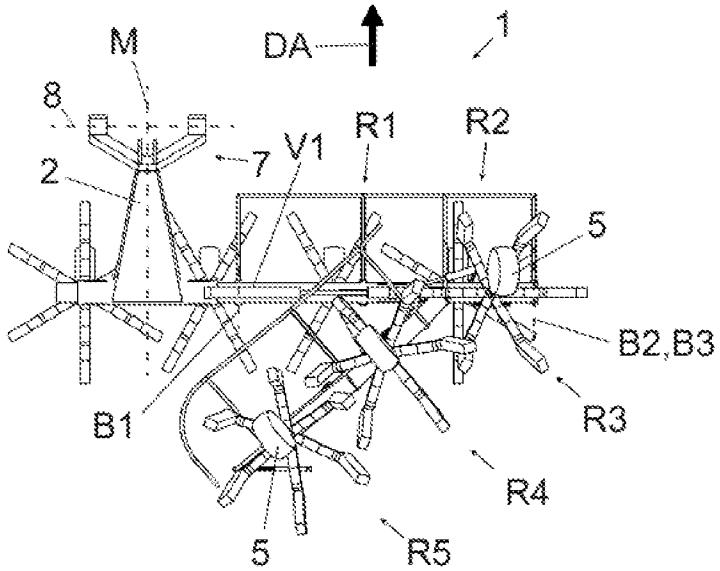
[Fig. 8]



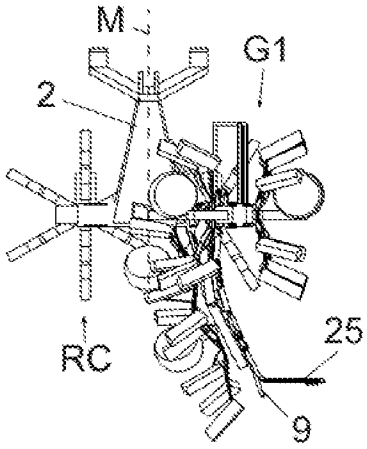
[Fig. 9A]



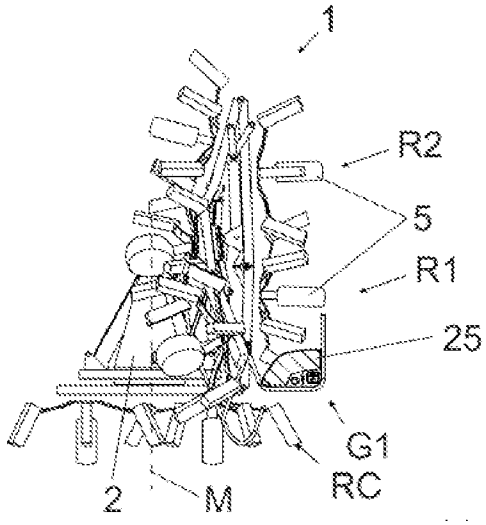
[Fig. 9B]



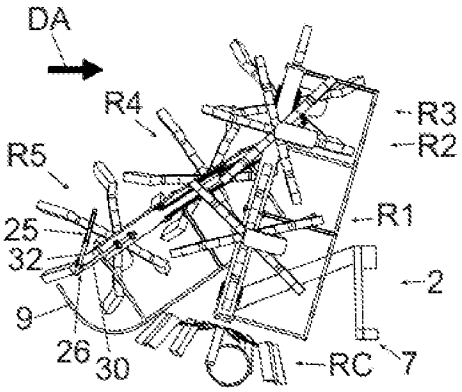
[Fig. 10A]



[Fig. 10B]



[Fig. 10C]



[Fig. 11]