



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.08.2019 Bulletin 2019/35

(51) Int Cl.:
E01H 5/06 (2006.01) E02F 3/76 (2006.01)

(21) Application number: **19156332.9**

(22) Date of filing: **11.02.2019**

(84) Designated Contracting States:
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
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(71) Applicant: **Tiainen, Martti**
75500 Nurmes (FI)

(72) Inventor: **Tiainen, Martti**
75500 Nurmes (FI)

(74) Representative: **Genip Oy**
Heikinkatu 7
48100 Kotka (FI)

(30) Priority: **22.02.2018 FI 20185161**

(54) **SUSPENSION ARRANGEMENT OF UNDERBODY GRADER USED IN A VEHICLE, WORK MACHINE OR SIMILAR, AS WELL AS VEHICLE, WORK MACHINE OR SIMILAR**

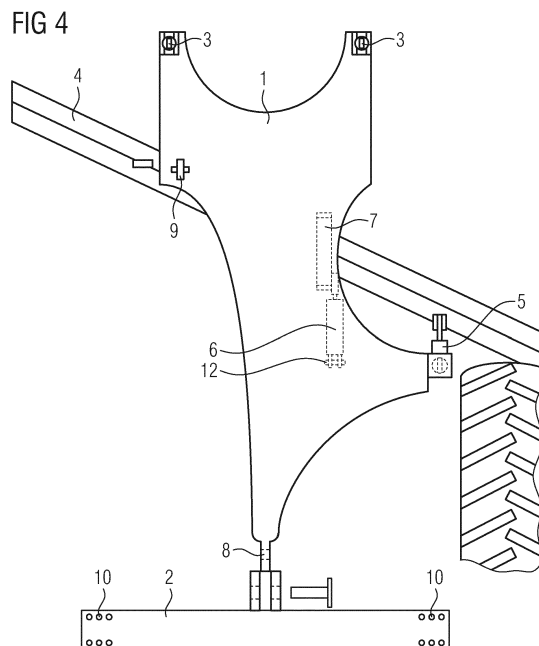
(57) The suspension arrangement of a blade (4) of an underbody grader (21) used in a vehicle, work machine or similar comprises:

- turning devices (5) for turning the blade (4) from the working position (I) to the transport position (II) and back; and
- transfer devices (6, 7, 9, 14), which have been arranged
 - to reduce the delivery angle of the blade before the blade (4) is turned from the working position (I) to the transport position (II) or at the same time as when the blade (4) is being turned from the working position (I) to the transport position (II), and
 - to increase the delivery angle of the blade after the blade (4) has been turned from the transport position (II) to the working position (I) or at the same time as when the blade (4) is being turned from the transport position (II) to the working position (I).

The transfer devices (6, 7, 14) have been adapted to transfer the turning joint (14) of the blade (4) to the first lateral direction, in which case the blade (4) rotates with respect to one joint (9) reducing the delivery angle, and to a second lateral direction, in which case the blade (4) rotates with respect to a second joint (9) increasing the delivery angle.

The room for movement of the transferable turning joint (14) has been implemented in a form-restricted member (7).

Also a parallel independent claim for a vehicle, work machine or similar.



Description

Field of invention

[0001] The invention is related to the suspension of underbody graders or underbody scrapers used in vehicles, work machines and similar.

Technical background

[0002] Underbody graders are used for example for levelling dirt roads and in the winter time for removing dense compacted snow from the surface of the road.

[0003] As an example, Vuomet Oy's Finnish patent 126587 presents an underbody grader intended for such purpose. The patent refers to the underbody grader in Finnish as "alusaura" (underbody plough). Since *plough* means not only a snow plough but also an agricultural tool used for ploughing a field, underbody grader should be considered a more descriptive name of the device due to its purpose. In this case, an underbody grader is an actual device unit to be connected to a vehicle, work machine or similar, which device unit also comprises a blade under the vehicle, work machine or similar, where blade refers to that part of the underbody grader which is in contact with the surface of the road and at the same time pushes the transferred material ahead of the blade.

[0004] Pajakulma Oy's European patent application publication EP 3 173 536 describes a mounting frame used in the suspension of the blade of an underbody grader.

[0005] The delivery angle of the blade of an underbody grader refers to the angle between the blade and the horizontal normal of the longitudinal axis of a vehicle, work machine or similar. When the delivery angle is 0, the blade is transversely in relation to the longitudinal axis.

Objective of invention

[0006] When the wheelbase of a vehicle, work machine or similar is short or relatively short in relation to the width of the blade used, such as especially in tractors or shorter trucks, the wheelbase may restrict the available delivery angle. In this case, it may be impossible to turn a blade especially with a relatively large delivery angle from the working position to the transport position, because the blade touches a tyre. This is why it is necessary to use a relatively small delivery angle especially in tractors and shorter trucks.

[0007] The problem with a relatively small delivery angle is that under certain circumstances, when the delivery angle is not sufficient for the circumstances, the material to be transferred does not move in the desired manner, and at worst the blade discharges the material to be transferred onto the road, not to the side of the shoulder of the road. Moreover, in this case the blade pushes a large amount of the material to be transferred in front of it with-

out discharging it to the side of the shoulder of the road, which increases the power demand of the vehicle, work machine or similar considerably. This has an adverse impact on fuel economy and increases the working time used.

[0008] One of the objectives of the invention is to enable an increase in the delivery angle of a blade used in an underbody grader. This objective can be solved by means of a suspension arrangement according to the independent claim and by means of a vehicle, work machine or similar according to the parallel independent claim.

[0009] The dependent claims describe the advantageous aspects of the suspension arrangement.

Advantages of invention

[0010] The suspension arrangement of a blade of an underbody grader used in a vehicle, work machine or similar comprises turning devices for turning the blade from the working position to the transport position and back. In addition to this, the suspension arrangement comprises transfer devices, which have been arranged

o to reduce the delivery angle of the blade before the blade is turned from the working position to the transport position or at the same time as when the blade is being turned from the working position to the transport position, and

o to increase the delivery angle of the blade after the blade has been turned from the transport position to the working position or at the same time as when the blade is being turned from the transport position to the working position.

[0011] As a result of the transfer devices - in other words also because the delivery angle of the blade is reduced when being turned from the working position to the transport position or before the blade is turned from the working position to the transport position - it is possible to use the blade in the working position at a delivery angle which is even so large that the blade would not have enough room to turn to the transport position, but the blade would touch the tyre.

[0012] The transfer devices have been adapted to transfer the turning joint of the blade to a first lateral direction, in which case the blade rotates with respect to one joint reducing the delivery angle, and to a second lateral direction, in which case the blade rotates with respect to a second joint increasing the delivery angle. This is a mechanically relatively simple method to reduce and increase the delivery angle of the blade by using a relatively simple mechanism.

[0013] The room for movement of the transferable turning joint is implemented in a form-restricted member, for example by arranging the transferable turning joint to be movable in a slot.

[0014] When the transfer devices in the suspension arrangement have been arranged to transfer the turning joint of the blade at the same time as when the turning devices are being used, it is possible to speed up the shift from the transport position to the working position and vice versa when it is not necessary to first use the transfer device and then the turning device (when shifting from the working position to the transport position) or to first use the turning device and then the transfer device (when shifting from the transport position to the working position), but these can be used simultaneously.

[0015] In its simplest configuration, the transferable turning joint is a movable hinge pin or comprises a movable hinge pin.

[0016] The transfer devices most advantageously comprise at least one hydraulic cylinder.

[0017] The transfer devices have most advantageously been suspended to the body plate of the underbody grader. In this case, the body plate has most advantageously been suspended at least by its one edge but most preferably by its both edges by means of a stabilising telescopic structure to the body of the vehicle, work machine or similar.

[0018] The blade has most advantageously been suspended to the transfer devices, such as to a hinge pin movable in a slot.

[0019] The turning devices advantageously comprise a hydraulic cylinder, which has been adapted to turn the blade in the lateral direction around the movable hinge pin.

[0020] It is advantageous to connect the hydraulic cylinder of the turning devices and the hydraulic cylinder of the transfer devices to the same hydraulic line.

[0021] The blade has most advantageously been fastened to the body plate by means of a second joint, such as a bull's eye, which is fixed, in which case the fixed joint forms a pivoted axis, around which the movable turning joint turns the blade.

[0022] A vehicle, work machine or similar according to the second aspect of the invention contains a blade fastened to a suspension arrangement of an underbody grader according to any one of the preceding claims.

List of drawings

[0023] In what follows, one embodiment of the invention is presented by means of the exemplary embodiment shown in the enclosed drawings. Of the drawings:

FIG 1 shows a conceptual drawing of a tractor where the blade of the underbody grader has been suspended by using the suspension arrangement;

FIG 2 shows a side view of the suspension arrangement according to FIG 1 when the blade is in the working position (position I);

FIG 3 shows a side view of the suspension arrangement according to FIG 1 when the blade is in the transport position (position II);

FIG 4 shows the suspension arrangement shown in FIG 1 - 3 viewed from the top; and

FIG 5 shows a detail of the pillar fastening of the underbody grader (section V-V).

[0024] The same reference numbers refer to the same technical parts in all FIGs.

Detailed description of the invention

[0025] FIG 1 shows a conceptual drawing of a tractor 20 where the blade 4 of an underbody grader 21 has been suspended by using the suspension arrangement according to the invention. The position of the blade 4 is changed between the working position I and transport position II (cf. also FIG 2 and 3) by means of a hydraulic cylinder 5. The hydraulic cylinder 5 is powered by the hydraulic system of the tractor 20.

[0026] In the embodiment example of the invention, the underbody grader 21 has been fastened to a tractor 20. Instead of a tractor, the underbody grader 21 can be used in a corresponding manner in other vehicle, work machine or similar.

[0027] The suspension arrangement comprises turning devices 5 for turning the blade 4 from the working position I to the transport position II and back, as well as transfer devices (hydraulic cylinder 6, transfer slot 7, bull's eye 9, hinge pin 14), which have been arranged

o to reduce the delivery angle of the blade before the blade 4 is turned from the working position I to the transport position II or at the same time as when the blade 4 is being turned from the working position I to the transport position II, and

o to increase the delivery angle of the blade after the blade 4 has been turned from the transport position II to the working position I or at the same time as when the blade 4 is being turned from the transport position II to the working position I.

[0028] FIG 2 shows a side view of the suspension arrangement according to FIG 1 when the blade 4 is in the working position (position I), and FIG 3 shows a side view of the suspension arrangement according to FIG 1 when the blade 4 is in the transport position (position II).

[0029] The transfer devices (hydraulic cylinder 6, transfer slot 7, hinge pin 14) have been adapted to transfer the turning joint (hinge pin 14) of the blade 4 to a first lateral direction (in other words forward), in which case the blade 4 rotates with respect to one joint (bull's eye 9) reducing the delivery angle, and to a second lateral direction (in other words backwards), in which case the

blade 4 rotates with respect to said second joint (bull's eye 9) increasing the delivery angle.

[0030] The transfer devices (hydraulic cylinder 6, transfer slot 7, hinge pin 14) have most advantageously been arranged to transfer the turning joint (hinge pin 14) of the blade 4 at the same time as when the turning devices (hydraulic cylinder 5) are being used.

[0031] The turning joint used is most advantageously a movable hinge pin 14 or it comprises a movable hinge pin.

[0032] The room for movement of the transferable turning joint 14 can most advantageously be implemented in a form-restricted member (transfer slot 7). The transferable turning joint (e.g. a hinge pin 14) has most advantageously been arranged to be movable in the slot 7.

[0033] The transfer position of the transferable turning joint 14 has most advantageously been selected so that the transferable turning joint 14 is at an edge of the form-restricted member or slot 7 so that the edge of the form-restricted member or slot 7 supports the transferable turning joint 14 against the forces directed at the blade 4 from the working direction of the blade 4. In this way, it is possible to receive the forces directed at the blade 4 during work in a way other than via the hydraulic cylinders 5, 6, which enables avoiding the breakage of the hydraulic cylinders 5, 6. In this case, the forces coming from the blade 4 are primarily directed from the base of the slot 7 to the body plate 1.

[0034] In the suspension system, a tractor-specific adaptation can be implemented by restricting the room for movement of the transferable turning joint 14 in the form-restricted member or slot 7 by installing in the form-restricted member or slot 7 a piece that prevents the movement of the transferable turning joint 14 in order to restrict the turning position of the blade 4, most advantageously for the reason that the blade 4 would not touch a wheel located behind the blade 4 in a vehicle, work machine or similar (cf. FIG 4).

[0035] The transfer devices (hydraulic cylinder 6, transfer slot 7, hinge pin 14) most advantageously comprise at least one hydraulic cylinder.

[0036] The hydraulic cylinder 6 has most advantageously been positioned so that when the blade 4 is in the working position, the form-restricted member or slot 7 supports the transferable turning joint (hinge pin 14) in order to receive the forces directed at the blade 4 from the working direction of the blade 4 or in order to reduce or eliminate the force components directed at the hydraulic cylinder 6 by such forces.

[0037] The transfer devices (hydraulic cylinder 6, transfer slot 7, hinge pin 14) have most advantageously been suspended, made or supported to the body plate 1 of the underbody grader 21.

[0038] The body plate 1 may be suspended at least by its one end by means of a stabilising telescopic structure 3 to the body of the vehicle, work machine or similar.

[0039] The blade 4 may be suspended to the transfer devices (hydraulic cylinder 6, transfer slot 7, hinge pin

14), most advantageously to a hinge pin 14 movable in the slot 7.

[0040] The turning devices (hydraulic cylinder 5) most advantageously comprise a hydraulic cylinder 5, which has been adapted to turn the blade 4 in the lateral direction (in other words in the forward-backwards direction) around the movable hinge pin 14.

[0041] The hydraulic cylinder 5 of the turning devices and the hydraulic cylinder 6 of the transfer devices have most advantageously been connected to the same hydraulic line.

[0042] The blade 4 has best been fastened to the body plate 1 by means of a second joint 9, such as a bull's eye, which is fixed, in which case the fixed joint 9 forms a pivoted axis, around which the movable turning joint 14 turns the blade 4.

[0043] A vehicle, work machine or similar contains a blade 4 fastened to a suspension arrangement of an underbody grader 21 according to any one of the preceding claims.

[0044] The body plate 1 is a plate (most advantageously approx. 40 - 50 mm thick) or plate structure. Its material is for example iron or steel.

[0045] The body plate 1 has been fastened by its back section to an auxiliary body 2 by means of a bull's eye 8 (cf. also FIG 4). The auxiliary body 2 has been fastened to the body structure of the tractor 20, most advantageously by means of bolt connections made at the through holes 10 of the auxiliary body 2. By its front section, the body plate 1 has been fastened most advantageously on both sides most preferably by means of an adjustable pillar 3 to the front section of the tractor 20.

[0046] The pillars 3 are most preferably implemented as a telescopic structure. In this case, the structure of the pillar 3 most advantageously includes a hydraulic cylinder operated by the hydraulics of the tractor 20, the top end 11 of which hydraulic cylinder has been fastened to a carrier structure 31 (such as to a plate), which has been fastened by means of bolt connections 63 to be installed to fastening points 33 (located for example in extensions 32) to fastening points (fastening part 33, which may be connected to the body of the tractor 20 by means of a bolt connection 61) located in the body of the tractor 20. Correspondingly, the lower end 13 of the hydraulic cylinder is fastened to the body plate 1 for example by means of a bull's eye. The top end 11 of the hydraulic cylinder may be protected by a first rhs tube, and the lower end 13 may be protected by a second rhs tube. In this case, the piston of the hydraulic cylinder is inside one rhs tube, and the arm is inside a second rhs tube. The rhs tubes are most advantageously cylindrical in shape. The diameter of the tubes is most advantageously such that both the arm of the hydraulic cylinder and the piston of the hydraulic cylinder have enough room to go through both tubes and that the tubes also have enough room to go one inside the other so that the arm can be run in (in order to raise the body plate 1) or out (in order to lower the body plate 1).

[0047] The blade 4 has been fastened by its one edge (most advantageously by the left edge in countries with right-hand driving or from the left edge in countries with left-hand driving - in other words from the side of the centre line of the road) by means of a bull's eye 9 to the body plate 1 and from its opposite edge (in other words from the side of the shoulder of the road) by means of a hinge pin 14 to the transfer slot 7. The hinge pin 14 used is most advantageously a hardened pin on top of which there is most preferably a hardened bushing. A hydraulic cylinder 5 fastened to the body plate 1 best works as the turning cylinder of the blade 4. In order to change the delivery angle, a hydraulic cylinder 6 has been fastened to the body plate 1 from the fastening point 26 by means of a bolt connection 12 and/or by welding, or in some other applicable manner.

[0048] The operating principle of the suspension arrangement of the underbody grader 21 is as follows: When the blade 4 is in the transport position (position II), the pillars 3 are up, as is the hydraulic cylinder 5.

[0049] In the transport position (position II), the location of the shoulder-side fastening point in the hydraulic cylinder 6 in the lateral direction is further down forward as compared to the working position (position I). In other words, the hinge pin 14 has been moved forward in the transfer slot 7, in which case the blade 4 has room to move to the upper position. Such a turning is enabled by the bull's eye 9 on the side of the centre line of the road.

[0050] When turned to the working position (position I), the hydraulic cylinder 5 is run out and at the same time the hydraulic cylinder 6 is used for shifting the location of the hinge pin 14 of the blade 4 in the transfer slot 7 to the back position, in which case it is most advantageously possible to utilise the entire wheelbase of the vehicle, work machine or similar.

[0051] The working depth of the blade 4 is adjusted by means of the adjustable pillars 3. The adjustable pillars 3 are used for adjusting the height position of the body plate 1. If necessary, the pillars 3 can be used for tilting the blade 4 as much as needed, depending on the inclination of the road surface. This is enabled by a bull's eye located at the lower end of each pillar 3, for example at the lower end 13 of the hydraulic cylinder.

[0052] The suspension arrangement according to the invention accomplishes the advantage that the entire available wheelbase of the vehicle, work machine or similar - irrespective of the make - can be utilised. At the same time, it is possible to relieve the restriction of the delivery angle resulting from a restricted wheelbase as compared to underbody graders which have a blade with a fixed hinge line in the front-back direction.

[0053] When it is possible to reduce the delivery angle when shifting from the working position to the transport position, it is possible to use the blade 4 in the working position in the front-back direction at a delivery angle that is bigger than with underbody graders equipped with a fixed hinge line. An advantage of a bigger delivery angle is that the movement of the material to be transferred is

improved and the discharge of the blade 4 to the side of the shoulder of the road is improved. At the same time, it is possible to reduce the amount of power needed for pushing, which enables a reduction in the fuel consumption and/or an increase in the ploughing speed.

[0054] Another significant advantage is that when the location of the hinge pin 14 in the transfer slot 7 is changeable, it is possible to make the blade 4 higher and straighter than conventionally, in which case it is possible to implement the space reserved for the transfer of the material as a bigger space. If the hinge line of the blade 4 in the front-back direction is fixed and if the delivery angle needs to be bigger, the blade 4 must be made more convex, in which case the material is in a way forced to move out through a narrower gap, which increases resistance.

[0055] The blade 4 can be brought higher in the transport position, when the location of the hinge pin 14 in the transfer slot 7 is transferable. In this case, the blade 4 can be implemented as more uniform. In addition to this, the suspension system in itself is very low also in terms of the body, in which case the underbody grader 21 reduces the ground clearance of the vehicle, work machine or similar less than a prior art underbody grader.

[0056] Moreover, the suspension system is really simple, in which case the underbody grader 21 can be built cost-effectively, and its operational reliability can be increased.

[0057] The invention should not be understood to be limited only by the below claims, but the invention is to be understood to include all their legal equivalents and the combinations of the embodiments presented.

List of reference numbers used:

[0058]

- | | |
|----|---------------------------------|
| 1 | body plate |
| 2 | auxiliary body |
| 3 | pillar |
| 4 | blade |
| 5 | hydraulic cylinder |
| 6 | hydraulic cylinder |
| 7 | transfer slot |
| 8 | bull's eye |
| 9 | bull's eye |
| 10 | through hole |
| 11 | upper end of hydraulic cylinder |
| 12 | bolt connection |
| 13 | lower end of hydraulic cylinder |
| 14 | hinge pin |
| 20 | tractor |
| 21 | underbody grader |
| 22 | fastening protrusion |
| 23 | joint |
| 24 | arm of hydraulic cylinder |
| 25 | fastening protrusion |
| 26 | fastening point |
| 31 | carrier structure |

- 32 extension
- 33 fastening points
- 61 connecting bolt
- 62 body (of tractor)
- 63 bolt connection
- 64 fastening part

Claims

1. A suspension arrangement of a blade (4) of an underbody grader (21) used in a vehicle, work machine or similar, which suspension arrangement comprises:

- turning devices (5) for turning the blade (4) from the working position (I) to the transport position (II) and back; and
- transfer devices (6, 7, 9, 14), which have been arranged

- to reduce the delivery angle of the blade before the blade (4) is turned from the working position (I) to the transport position (II) or at the same time as when the blade (4) is being turned from the working position (I) to the transport position (II), and
- to increase the delivery angle of the blade after the blade (4) has been turned from the transport position (II) to the working position (I) or at the same time as when the blade (4) is being turned from the transport position (II) to the working position (I).

The transfer devices (6, 7, 14) have been adapted to transfer the turning joint (14) of the blade (4) to a first lateral direction, in which case the blade (4) rotates with respect to one joint (9) reducing the delivery angle, and to a second lateral direction, in which case the blade (4) rotates with respect to a second joint (9) increasing the delivery angle.

The suspension arrangement is **characterised in that:**

the room for movement of the transferable turning joint (14) has been implemented in a form-restricted member (7).

2. A suspension arrangement according to claim 1, where the transferable turning joint (14) has been arranged to be movable in a slot (7).
3. A suspension arrangement according to claim 1 or 2, where the transfer devices (6, 7, 14) have been arranged to transfer the turning joint (14) of the blade (4) at the same time as when the turning devices (5) are being used.
4. A suspension arrangement according to any one of

the claims 1 - 3, where the transferable turning joint (14) is a movable hinge pin or comprises a movable hinge pin.

5. A suspension arrangement according to any one of the preceding claims, where the transfer position of the transferable turning joint (14) has been selected so that the transferable turning joint (14) is at an edge of the form-restricted member or slot (7) so that the edge of the form-restricted member or slot (7) supports the transferable turning joint (14) against the forces directed at the blade (4) from the working direction of the blade (4).

6. A suspension arrangement according to claim 5, where the room for movement of the transferable turning joint (14) in the form-restricted member or slot (7) has been restricted by installing in the form-restricted member or slot (7) a piece that prevents the movement of the transferable turning joint (14) in order to restrict the turning position of the blade (4), most advantageously for the reason that the blade (4) would not touch a wheel located behind the blade (4) in a vehicle, work machine or similar.

7. A suspension arrangement according to any one of the preceding claims 1 - 6, where the transfer devices (6, 7, 14) comprise at least one hydraulic cylinder (6).

8. A suspension arrangement according to claim 7 and either one of the claims 5 and 6, where the hydraulic cylinder (6) has been positioned so that when the blade (4) is in the working position, the form-restricted member or slot (7) supports the transferable turning joint (14) in order to receive the forces directed at the blade (4) from the working direction of the blade (4) or in order to reduce or eliminate the force components directed at the hydraulic cylinder (6) by such forces.

9. A suspension arrangement according to any one of the preceding claims, where the transfer devices (6, 7, 14) have been suspended, made or supported to the body plate (1) of the underbody grader (21).

10. A suspension arrangement according to claim 9, where the body plate (1) has been suspended at least by its one edge by means of a stabilising telescopic structure (3) to the body of the vehicle, work machine or similar.

11. A suspension arrangement according to claim 9 or 10, where the blade (4) has been suspended to the transfer devices (6, 7, 14), most advantageously to a hinge pin (14) movable in the slot (7).

12. A suspension arrangement according to any one of the preceding claims, where the turning devices (5)

comprise a hydraulic cylinder (5), which has been adapted to turn the blade (4) in the lateral direction around the movable hinge pin (14).

13. A suspension arrangement according to claim 12, 5
where the hydraulic cylinder of the turning devices
(5) and the hydraulic cylinder of the transfer devices
(6) have been connected to the same hydraulic line.
14. A suspension arrangement according to any one of 10
the preceding claims, where the blade (4) has been
fastened to the body plate (1) by means of a second
joint (9), such as a bull's eye, which is fixed, in which
case the fixed joint (9) forms a pivoted axis, around 15
which the movable turning joint (14) turns the blade
(4).
15. A vehicle (20), work machine or similar, which con- 20
tains a blade (4) fastened to a suspension arrange-
ment of an underbody grader (21) according to any
one of the preceding claims.

25

30

35

40

45

50

55

FIG 1

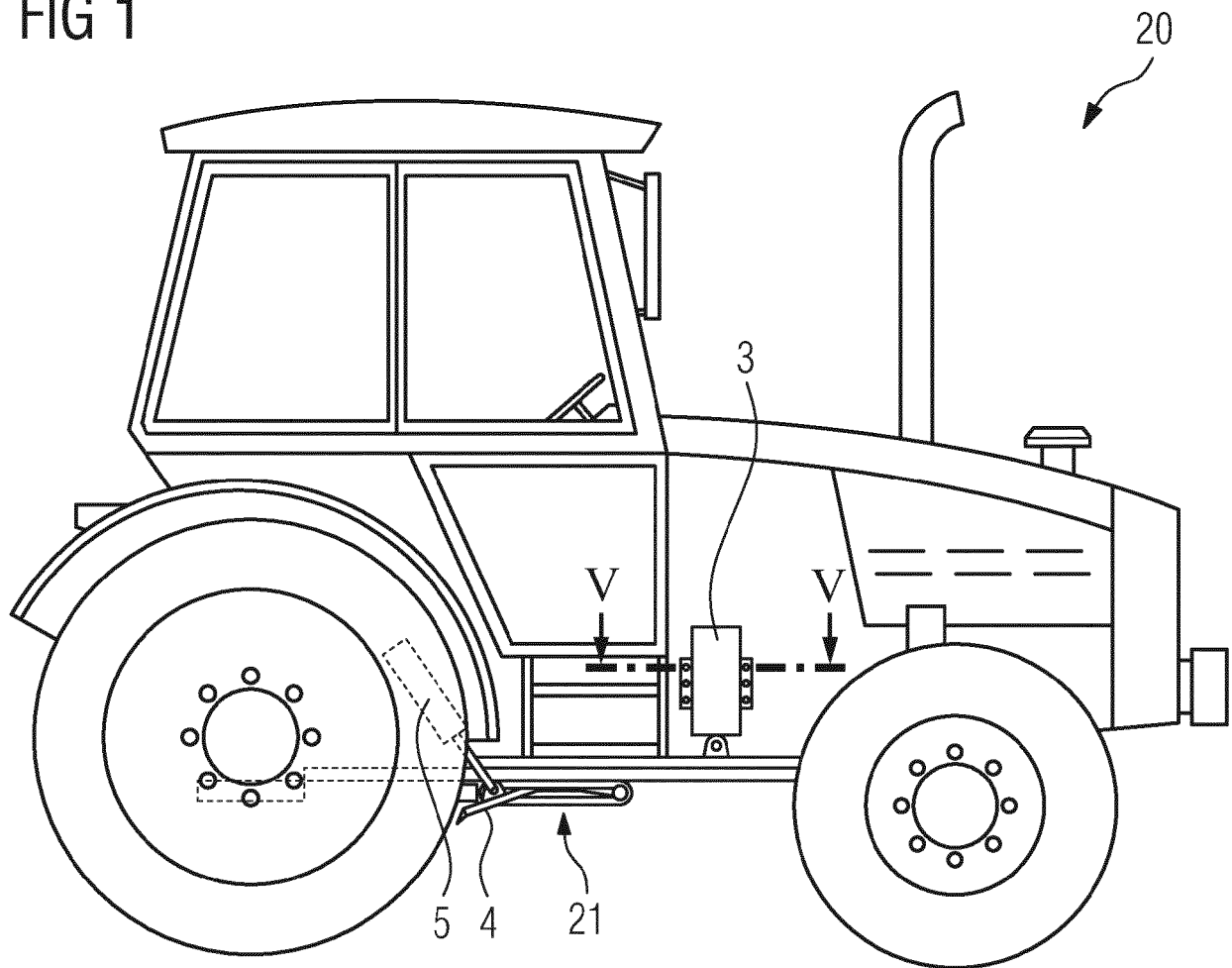


FIG 2

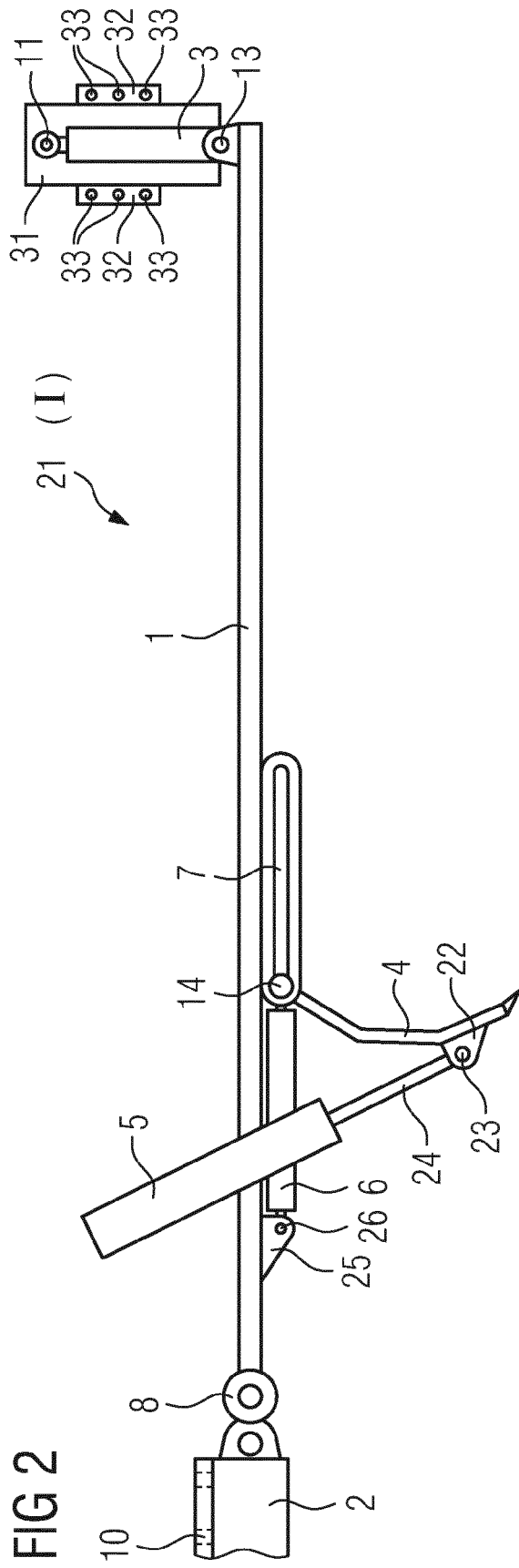


FIG 3

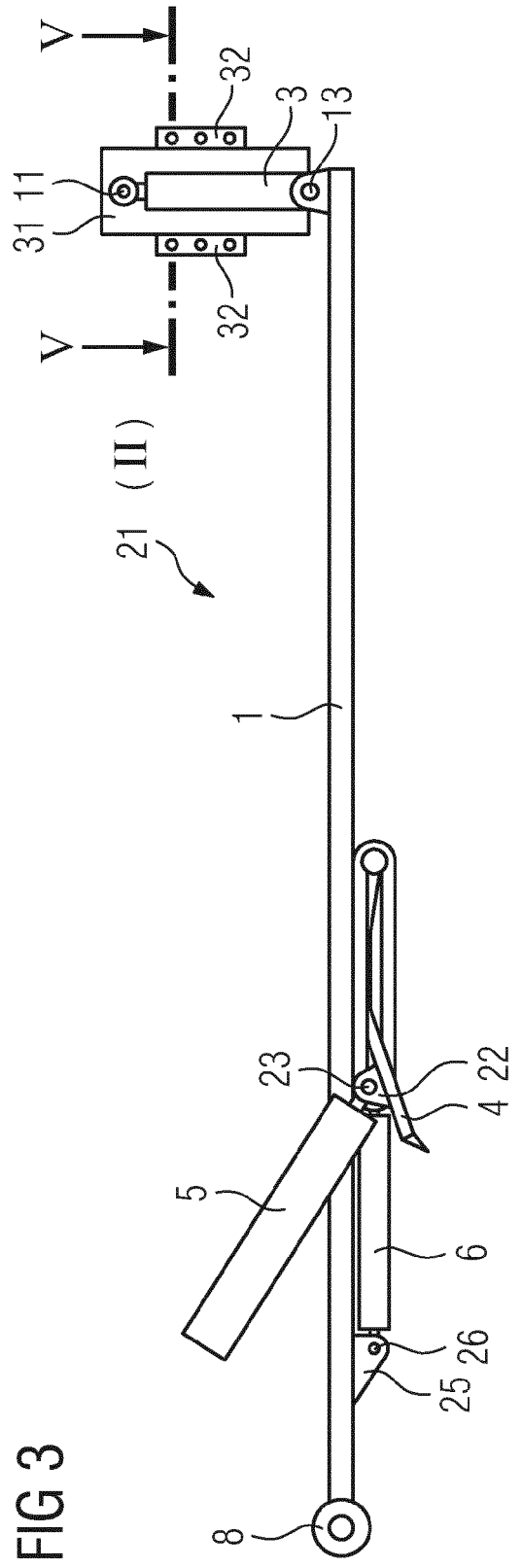


FIG 4

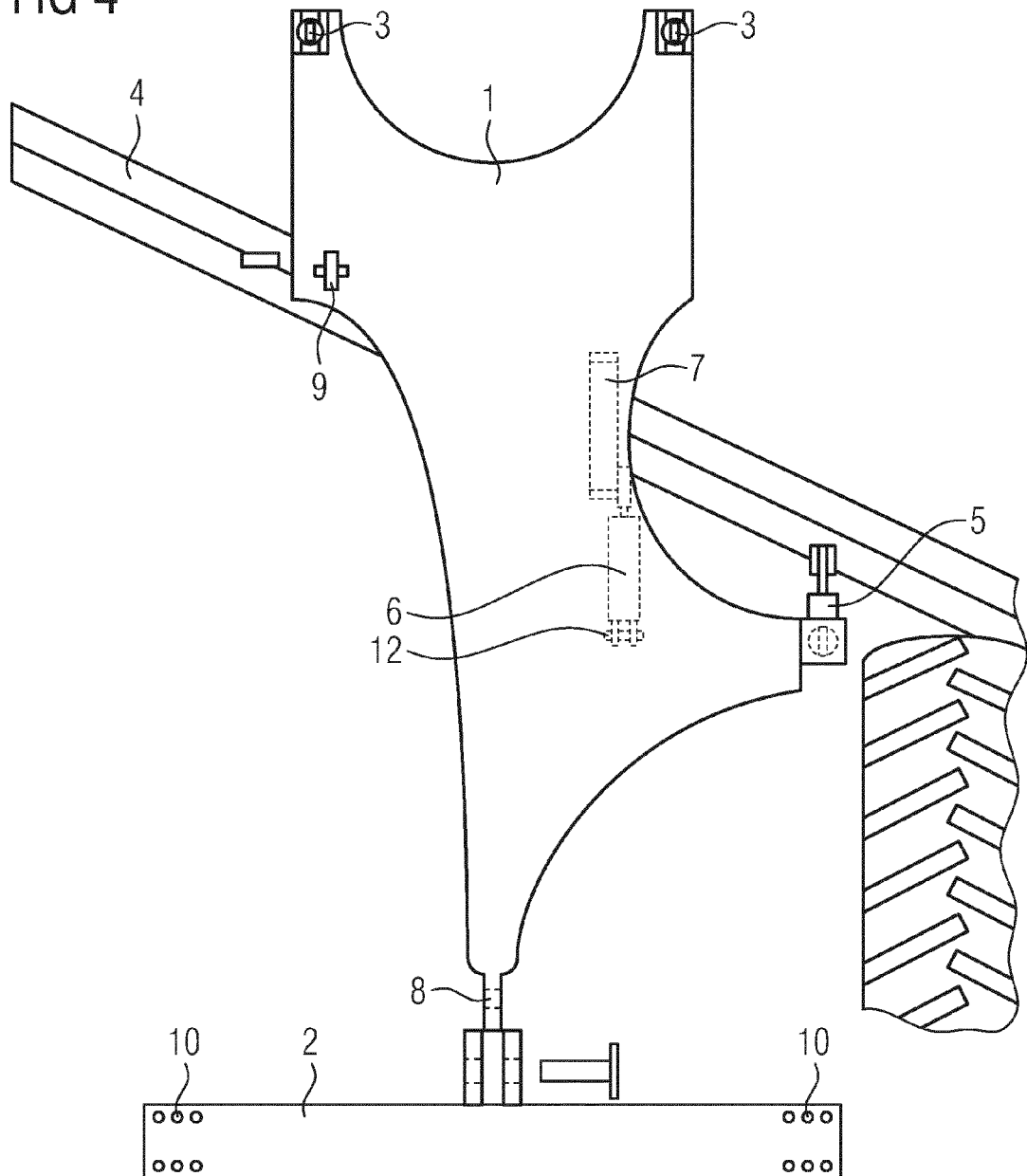
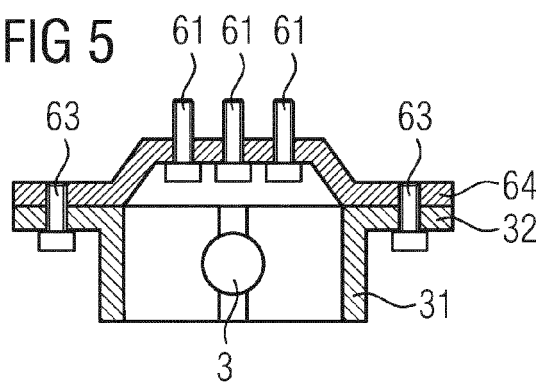


FIG 5





EUROPEAN SEARCH REPORT

Application Number
EP 19 15 6332

5

10

15

20

25

30

35

40

45

50

55

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X,D	EP 3 173 536 A1 (PAJAKULMA OY [FI]) 31 May 2017 (2017-05-31) * figure 3 *	1-4,7, 9-15 5	INV. E01H5/06
A	----- US 6 324 775 B1 (HARNOIS NORMAND [CA] ET AL) 4 December 2001 (2001-12-04) * figures 7a, 7b *	1	ADD. E02F3/76
A	----- US 2003/188461 A1 (VERMEULEN DAVID M [US] ET AL) 9 October 2003 (2003-10-09) * figure 2 *	1	

			TECHNICAL FIELDS SEARCHED (IPC)
			E01H E02F
The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 9 July 2019	Examiner Saretta, Guido
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

EPO FORM 1503 03/02 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 19 15 6332

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

09-07-2019

10

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
EP 3173536	A1	31-05-2017	NONE
US 6324775	B1	04-12-2001	NONE
US 2003188461	A1	09-10-2003	NONE

15

20

25

30

35

40

45

50

55

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- FI 126587 [0003]
- EP 3173536 A [0004]