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(54) **Title:** LINKAGE ARRANGEMENT

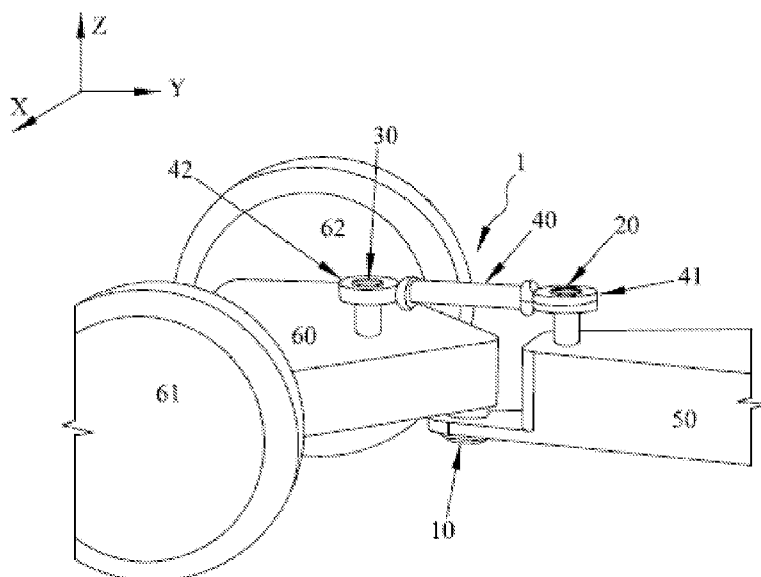


Fig. 1

(57) **Abstract:** A linkage arrangement for an articulated vehicle. The linkage arrangement (1) comprises a front frame (50) of the articulated vehicle, a rear frame (60) of the articulated vehicle, and a first pivot joint (10) interconnecting the front frame (50) and the rear frame (60) such that the front frame (50) and the rear frame (60) are pivotable relative each other about the first pivot joint (10). The linkage arrangement also comprises a link (40) having a fixed length. The link has a front end (41) pivotably connected to the front frame (50) by means of a second pivot joint (20), and a rear end (42) pivotably connected to the rear frame (60) by means of a third pivot joint (30). A projection of the first pivot joint (10) on the link (40) is positioned between the second (20) and third (30) pivot joints, at a first distance (D12) from the second (20) pivot joint and at a second distance (D13) from the third pivot joint (30).

LINKAGE ARRANGEMENT

TECHNICAL FIELD

This disclosure relates to linkage arrangements and in particular to linkage arrangements arranged for interconnecting forward and rearward units of articulated vehicles.

5

BACKGROUND OF THE INVENTION

Vehicles of the type known as articulated vehicles or articulated frame vehicles are well known. Such vehicles typically comprise forward and rearward units interconnected by an articulated joint.

10

A commonly used arrangement for connecting the front and rearward units of an articulated vehicle comprises two spherical bearings arranged on the same vertical line and a third spherical bearing on a horizontal distance away from the other spherical bearings but on same vertical level as one of the first two. US3912300 discloses a linkage

15 arrangement of that kind.

When using an articulated joint as described above, certain maneuvers might lead to undesired instability of the vehicle.

20 Accordingly, there is a need for an improved joint arrangement for an articulated vehicle, which arrangement provides improved stability of the vehicle.

SUMMARY OF THE INVENTION

In view of the aforementioned respects of known articulated vehicles, an object of the
25 invention is to create an improved and/or alternative solution for articulated vehicles that may alleviate at least some of the mentioned drawbacks with present articulated vehicles.

The object is wholly or partially achieved by a linkage arrangement for an articulated vehicle and an articulated vehicle according to the respective appended independent
30 claims. Embodiments are set forth in the appended dependent claims, in the following description and in the drawings.

According to a first aspect of the invention, there is provided a linkage arrangement for an articulated vehicle. The linkage arrangement comprises a front frame of the articulated vehicle and a rear frame of the articulated vehicle. The arrangement also comprises a first pivot joint interconnecting the front frame and the rear frame such that the front frame and the rear frame are pivotable relative each other about the first pivot joint. Furthermore the linkage arrangement comprises a link having a fixed length. The link has a front end pivotably connected to the front frame by means of a second pivot joint, and a rear end pivotably connected to the rear frame by means of a third pivot joint. A projection of the first pivot joint on the link is positioned between the second and third pivot joints, at a first distance from the second pivot joint and at a second distance from the third pivot joint. Thereby an enhanced stability of the vehicle is achieved.

According to an embodiment the pivot joints are configured so as to allow pivoting in directions which extend in separate planes. Thereby, the articulated joint becomes flexible and adaptable to different situations.

According to an embodiment, at least one of the pivot joints is a spherical bearing.

According to another embodiment, at least one of the pivot joints is a ball joint.

According to another embodiment the first distance and the second distance are essentially equal when a longitudinal axis of the front frame is parallel to a longitudinal axis of the rear frame.

According to yet another embodiment the a front frame has a first wheel axle and the rear frame has a second wheel axle, and a third distance between the first pivot joint and the first wheel axle differs from a fourth distance between the first pivot joint and the second wheel axle when a longitudinal axis of the front frame is parallel to a longitudinal axis of the rear frame. Thereby, the minimum turning radius of the vehicle comprising the articulated joint might decrease compared to vehicles in which the third distance and the fourth distance are essentially equal.

According to yet another embodiment, the fourth distance is smaller than the third distance.

According to yet another embodiment, the ratio between the third distance and the fourth distance is about 3 (three).

According to yet another embodiment the rear frame and the front frame are parts of an
5 articulated lawn mower.

According to a second aspect of the invention, there is provided an articulated lawn mower comprising an articulated joint according to the first aspect of the invention. Since articulated lawn mowers are often working on inclined and irregular surfaces, the
10 enhanced stability provided by the articulated joint according to the present invention is particularly favorable for them.

DEFINITIONS

As used herein the following terms have the following meanings:

15

The X-, Y- and Z-directions are defined based on a horizontal surface on which the articulated vehicle may be supported.

The “horizontal plane” refers to the plane in which the horizontal surface extends, and is
20 defined by the X and Y directions.

The “longitudinal direction” is the Y-direction, as best shown in Fig. 2.

The “lateral direction” is the X-direction, as best shown in Figs. 3a and 3b.

25

The “vertical direction” is defined by the Z-axis (as shown in Fig. 2), and is orthogonal the horizontal plane.

The “neutral position” of the vehicle refers to a position in which the front and rear frames
30 of the vehicle are connected such that their longitudinal axes are substantially parallel to each other and to the Y-direction.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be understood and appreciated more fully from the following detailed description, taken in conjunction with the drawings, in which:

Fig. 1 is a schematic perspective view of linkage arrangement in accordance with the
5 current disclosure.

Fig. 2 is a schematic side view of a front frame and a rear frame of an articulated vehicle comprising the linkage arrangement of Fig. 1.

Fig. 3a is a schematic top plan view of an articulated vehicle in a neutral position.

Fig. 3b is a schematic top plan view of an articulated vehicle in an articulated position.

10 Fig. 4 is a schematic top plan view of the linkage arrangement of Fig. 1.

Fig. 5 is a schematic side view of the articulated joint of Fig. 1, in a first, neutral position.

Fig. 6 is a schematic side view of the articulated joint of Fig. 1 in a second, articulated position.

Fig. 7 is a schematic rear view of the articulated joint of Fig. 5, in an articulated position.
15

DESCRIPTION OF PREFERRED EMBODIMENTS

The present invention will be described more fully hereinafter with reference to the accompanying drawings, in which preferred embodiments of the invention are shown. The invention may, however, be embodied in many different forms and should not be
20 construed as limited to the embodiments set forth herein; rather these embodiments are provided so that this disclosure will be thorough and complete, and will fully convey the scope of the invention to those skilled in the art. In the drawings, like numbers refer to like elements.

25 Fig. 1 shows a linkage arrangement 1 according to an embodiment of the present invention. The linkage arrangement 1 connects a rear frame 60 of an articulated vehicle 100 to a front frame 50 of the articulated vehicle 100.

The articulated vehicle 100 may be any suitable vehicle or machine, such as an
30 articulated lawn mower or an articulated wheel loader. In the embodiment disclosed herein, the articulated vehicle is an articulated ride-on lawn mower.

The front frame 50 and the rear frame 60 may be supported by wheels 51, 52, 61, 62, as shown in the figures.

The linkage arrangement 1 comprises three pivot joints 10, 20, 30. According to an embodiment of the invention, the joints are implemented as spherical bearings 10, 20, 30. One or several of the joints 10, 20, 30 may alternatively be implemented as other types of joints allowing pivoting in several directions. Examples of such bearings are ball joint rod end bearings and radial spherical plain bearings.

A first pivot joint 10 interconnects the rear frame 60 and the front frame 50.

10 A second pivot joint 20 interconnects the front frame 50 and a link member 40, which has a fixed length. The link member 40 may be a rod 40, having a first end 41 and a second end 42. The first end 41 of the link 40 is connected to the front frame 50 by means of the second pivot joint 20. The second end 42 of the link 40 is connected to the rear frame 60 by means of a third pivot joint 30. The fixed length of the link member 40 implies that the
15 second 20 and third 30 pivot joints are positioned at a fixed distance D1 from each other.

When the articulated vehicle is in a neutral position, the second 20 and third 30 pivot joints may be positioned at substantially the same level in the vertical direction. The link 40 between the two pivot joints 20, 30 may then extend in a direction that is essentially
20 parallel to the Y-direction. In Fig. 4 the position of the link when the vehicle is in the neutral position is shown with solid lines. In the neutral position, the extension direction of the link may also coincide with the longitudinal axis L50 of the front frame, as well as with the longitudinal axis L60 of the rear frame 60.

25 The first pivot joint 10 is positioned closer to the supporting surface 101 than the other two pivot joints 20, 30.

When the articulated vehicle is in the neutral position, the three pivot joints 10, 20, 30 may lie in a plane that is essentially parallel to the YZ-plane.

30

The orthogonal projection of the first pivot joint 10 on a line intersecting the second and third pivot joints is positioned between the second pivot joint 20 and the third pivot joint 30, as shown e.g. in Fig. 5. In prior art arrangements of the type comprising three pivot joints, the orthogonal projection of a lower pivot joint on a line defined by the other two
35 pivot joints would coincide with one of the other two pivot joints. In the embodiment shown

in Fig. 5, the orthogonal projection of the first pivot joint is positioned at a first distance D12 from the second pivot joint 20 and at a second distance D13 from the third pivot joint 30.

- 5 The first pivot joint 10 defines the main steering point of the vehicle. As shown in Fig. 4, a steering cylinder 70 connected to the front frame (not shown in Fig. 4) controls the position of the rear frame 60 relative to the front frame 50 around the first pivot joint 10.

If the front frame 50 and rear frame 60 would not have been connected to each other by means of the fixed length link, it would have been possible for the a front frame 50 and the rear frame 60 to pivot relative each other about a vertical axis intersecting the first pivot joint 10.

In that case, a turning movement of the rear frame 60 relative to the front frame 50 could involve a movement of the third pivot joint 30 along a first curve 301 from a first point 201 to a second point 203, in the XY-plane, as shown in Fig. 4. Then, the first pivot joint 10 could remain in a fixed position relative to the front frame 50.

However, since the third pivot joint 30 is not only connected to the first pivot joint 10, but also to the second pivot joint 20 by means of the link member 40, and since the distance D1 between the second 20 and third 30 pivot joints is fixed due to the link member 40, such a movement of the second pivot joint in the XY-plane only is not possible.

If the third pivot joint 30 would not have been connected to the first pivot joint 10, but to the second pivot joint 20 only, by means of the fixed length link member 40, a turning of the rear frame 60, and thereby the third pivot joint 30 relative to the front frame 50 and the second pivot joint 20 could imply a movement of the third pivot joint 30 along a second curve 302 in the XY-plane, from the first point 201 to a third point 202.

Since the first 301 and the second 302 curves are not identical, the first pivot joint 10 is forced to leave its original position 201 during turning of the rear frame 60, relative to the front frame 50. As best shown in Figs. 6 and 7, the pivot joint 10 might be forced to move in a lateral direction as well as in the vertical direction.

Fig. 7 is a rear view of the rear frame 60 and the first 10 and third 30 pivot joints, when the rear frame 60 is in an articulated position relative to the front frame 50.

In a neutral position, there will be no distance in the XY-plane between pivot joint 10 and the link member 40. As can be seen in Figs. 4, and 7, there is a distance in the XY-plane between pivot joint 10 and the link member 40 when the vehicle is in an articulated
5 position.

The above described configuration of the articulated link arrangement 1, implies that the pressure on the wheels 51, 52, 61, 62, is more evenly distributed when the vehicle is articulated than if a configuration as the one described in US3912300 would have been
10 used. Accordingly, an enhanced stability of the articulated vehicle is achieved.

According to an embodiment of the invention, the linkage arrangement 1 is configured such that the projection of the first pivot joint 10 on the link 40 is positioned at essentially equal distances D12, D13 from the second 20 and third 30 pivot joints, when the vehicle is
15 in a neutral position. Other configurations are also possible.

As shown in Fig. 3a, the front frame 50 of the articulated vehicle 100 can have a first wheel axle 53 and the rear frame can have a second wheel axle 63. When the articulated vehicle 100 is in a neutral position, there is a third distance D15 in the longitudinal
20 direction between the first pivot joint 10 and the first wheel axle 53 and a fourth distance D16 in the longitudinal direction between the first pivot joint 10 and the second wheel axle 63. According to an embodiment, the third distance D15 is larger than the fourth distance D16.

25 According to an embodiment, the ratio between the third distance D15 and the fourth distance is about 3.

In the drawings and specification, there have been disclosed preferred embodiments and examples of the invention and, although specific terms are employed, they are used in a
30 generic and descriptive sense only and not for the purpose of limitation, the scope of the invention being set forth in the following claims.

CLAIMS

1. A linkage arrangement for an articulated vehicle, the linkage arrangement (1) comprising
 - a front frame (50) of the articulated vehicle;
 - 5 a rear frame (60) of the articulated vehicle;
 - a first pivot joint (10) interconnecting the front frame (50) and the rear frame (60) such that the front frame (50) and the rear frame (60) are pivotable relative each other about the first pivot joint (10),
 - a link (40) having a fixed length,
 - 10 wherein the link has a front end (41) pivotably connected to the front frame (50) by means of a second pivot joint (20), and a rear end (42) pivotably connected to the rear frame (60) by means of a third pivot joint (30);
 - wherein a projection of the first pivot joint (10) on the link (40) is positioned between the second (20) and third (30) pivot joints, at a first distance (D12) from
 - 15 the second (20) pivot joint and at a second distance (D13) from the third pivot joint (30).
2. The linkage arrangement according to claim 1, wherein the pivot joints (10, 20, 30) are configured so as to allow pivoting in directions which extend in separate
- 20 planes.
3. The linkage arrangement according to claim 1 or 2, wherein at least one of the pivot joints (10, 20, 30) is a spherical bearing.
- 25 4. The linkage arrangement according to any of claims 1-3, wherein at least one of the pivot joints (10, 20, 30) is a ball joint.
5. The linkage arrangement according to any of the preceding claims, wherein the front frame (50) has a first longitudinal axis (L50) and the rear frame (60) has a
- 30 second longitudinal axis (L60).
6. The linkage arrangement according to claim 5, wherein the first distance (D12), and the second distance (D13) are essentially equal when the first longitudinal axis (L50) is parallel to the second longitudinal axis (L60).

7. The linkage arrangement according to claim 5 or 6, wherein the a front frame (50) has a first wheel axle (53) and the rear frame (60) has a second wheel axle (63), and wherein a third distance (D15) between the first pivot joint (10) and the first wheel axle (51) differs from a fourth distance (D16) between the first pivot joint (10) and the second wheel axle (63) when the first longitudinal axis (L50) is parallel to the second longitudinal axis (L60).
8. The linkage arrangement according to claim 7, wherein the fourth distance (D16) is smaller than the third distance (D15).
9. The linkage arrangement according to claim 5 or 6, wherein the ratio between the third distance (D15) and the fourth distance (D16) is about 3 (three).
10. The articulated joint of any of the preceding claims, wherein the rear frame (60) and the front frame (60) are parts of an articulated lawn mower (100).
11. An articulated lawn mower comprising an articulated joint according to any of the preceding claims.

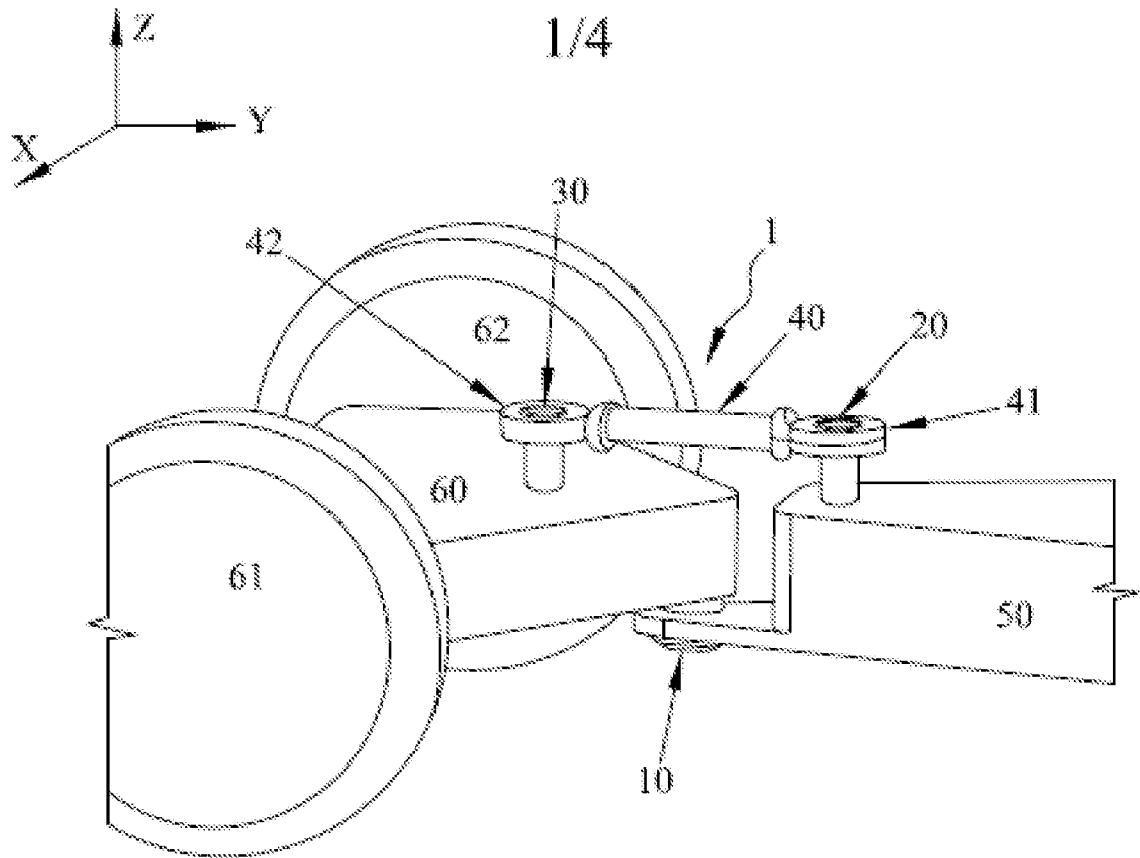


Fig. 1

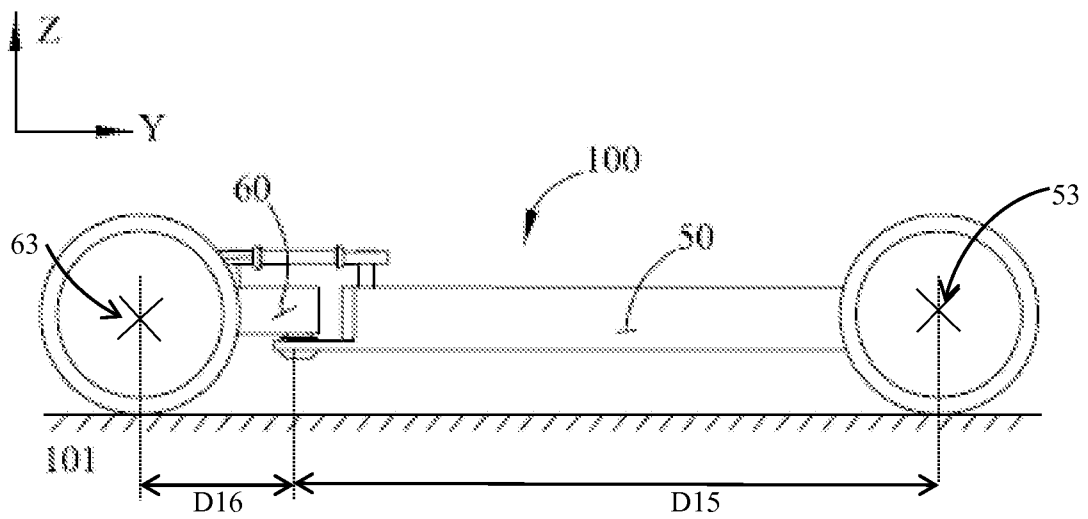


Fig. 2

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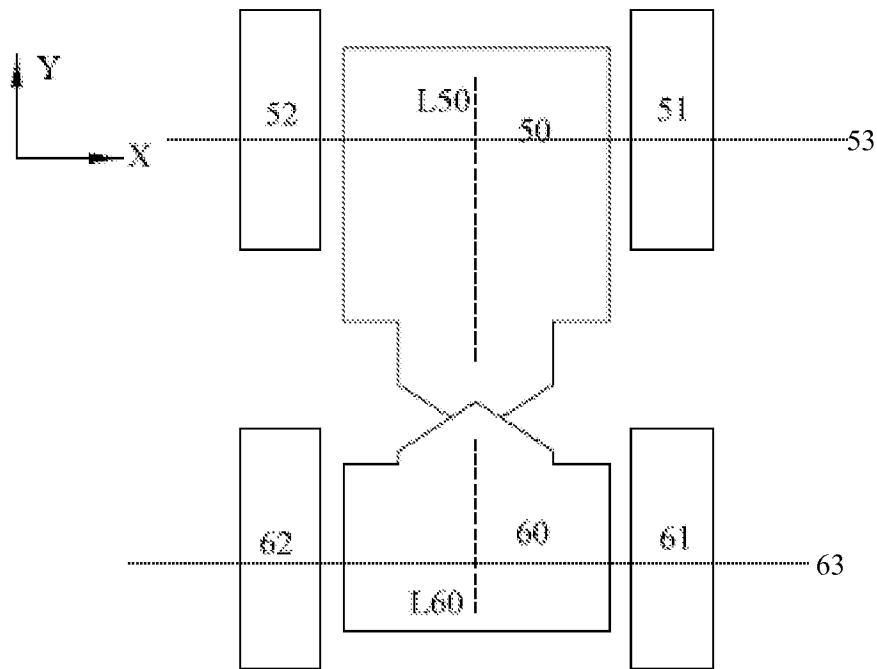


Fig. 3a

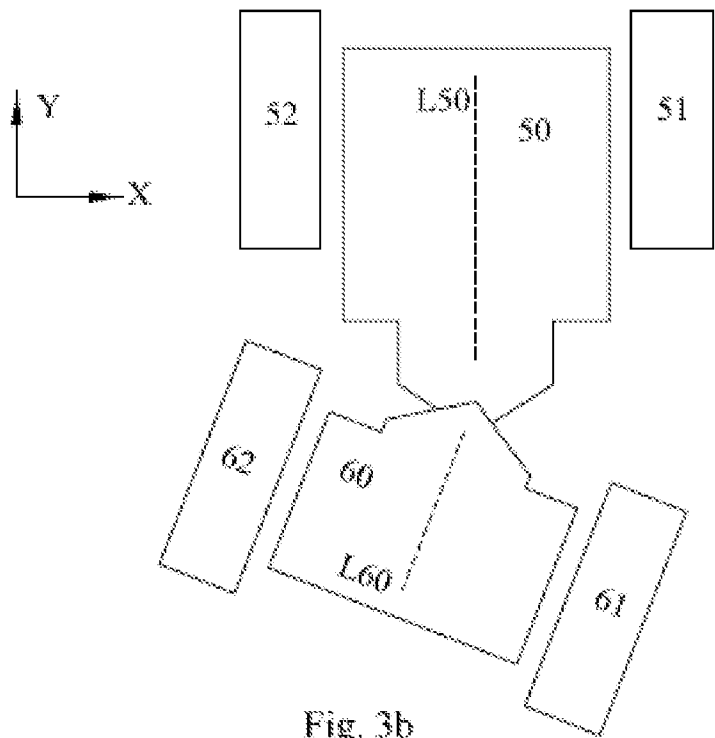


Fig. 3b

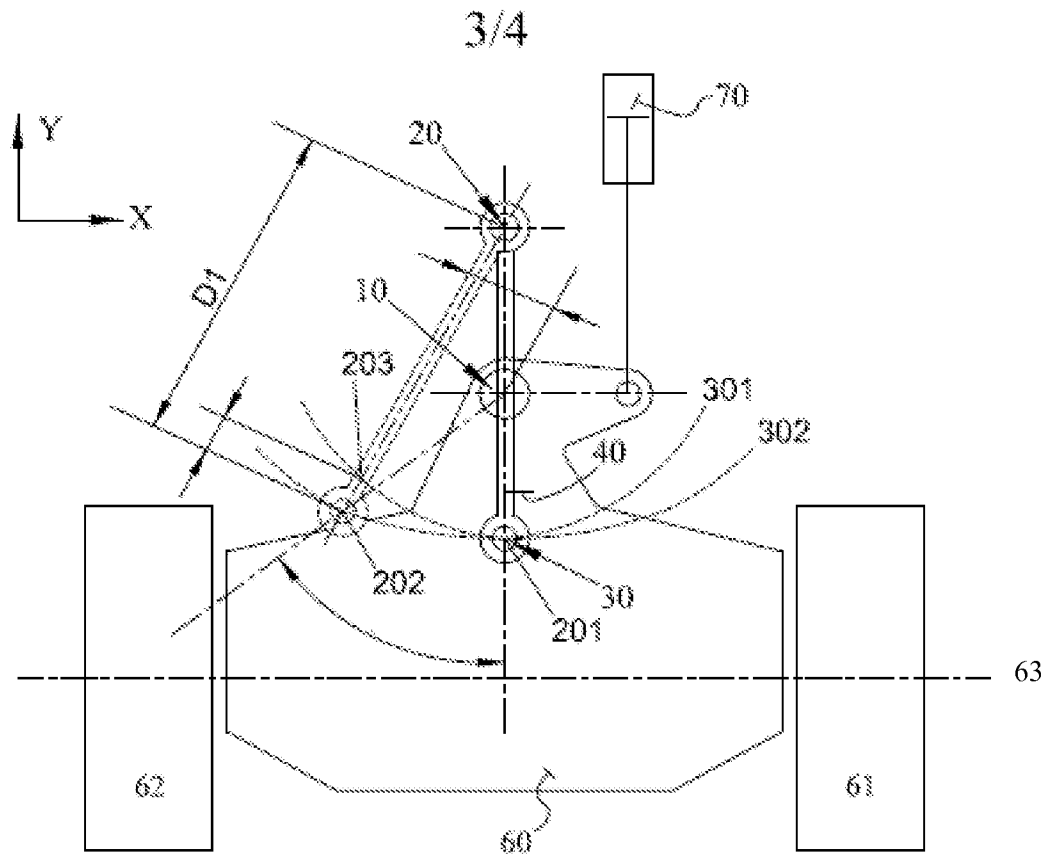


Fig. 4

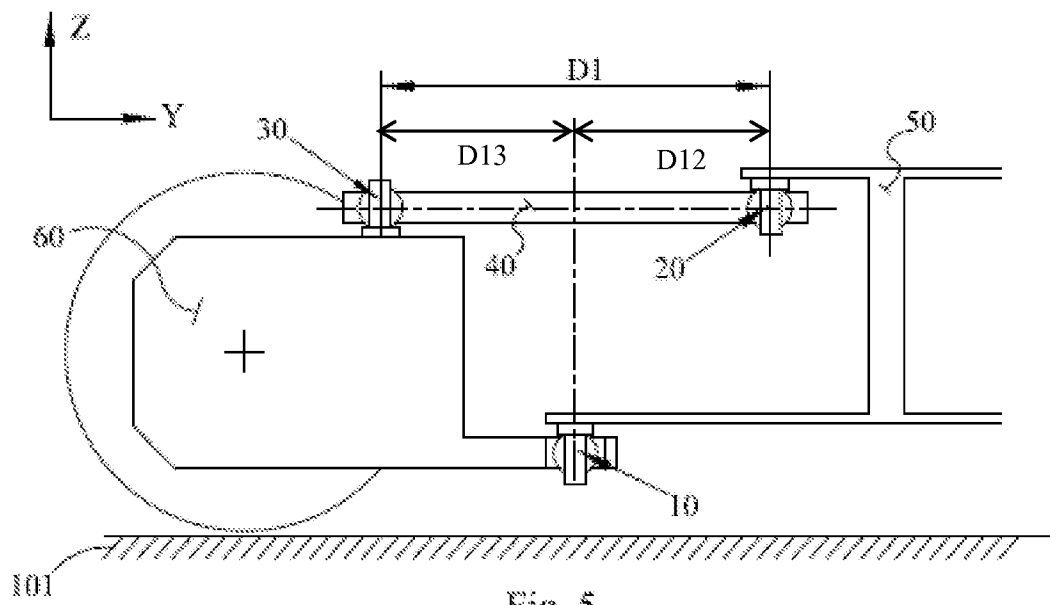


Fig. 5

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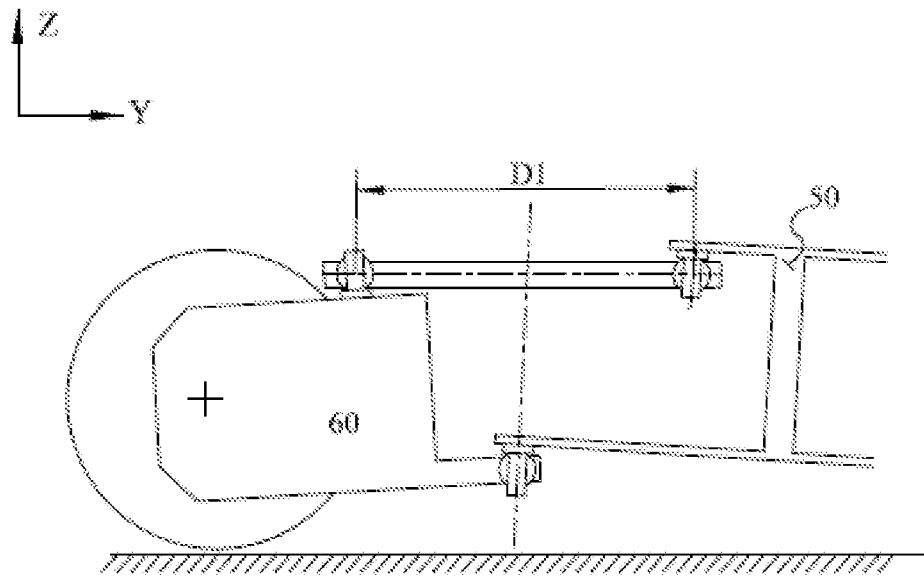


Fig. 6

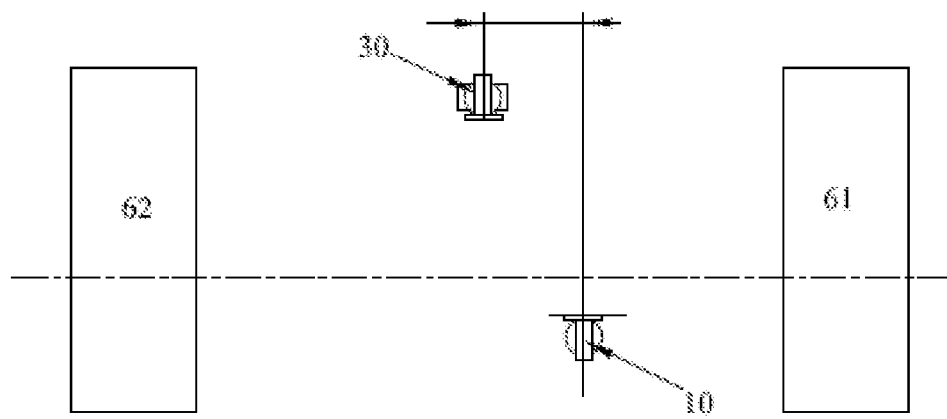


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/050137

A. CLASSIFICATION OF SUBJECT MATTER

IPC: see extra sheet

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC: A01D, B62D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

SE, DK, FI, NO classes as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal, PAJ, WPI data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 1111134 A2 (HAMM AG), 27 June 2001 (2001-06-27); abstract; paragraphs [0027], [0031]-[0041]; figures 1-3 --	1-11
A	US 3912300 A (BRYAN JR JOHN F), 14 October 1975 (1975-10-14); whole document --	1-11
A	DE 2547669 A1 (WEIDEMANN OSWALD), 28 April 1977 (1977-04-28); whole document --	1-11
A	FR 2534442 A1 (MASQUELIER ETS), 20 April 1984 (1984-04-20); whole document --	1-11



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Date of the actual completion of the international search

23-09-2011

Date of mailing of the international search report

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/SE2011/050137

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 3669469 A (HARTELIUS NILS MAGNUS), 13 June 1972 (1972-06-13) -- -----	1-11

Continuation of: second sheet

International Patent Classification (IPC)

B62D 53/02 (2006.01)

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Cited literature, if any, will be enclosed in paper form.

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.

PCT/SE2011/050137

EP	1111134 A2	27/06/2001	NONE
US	3912300 A	14/10/1975	NONE
DE	2547669 A1	28/04/1977	NONE
FR	2534442 A1	20/04/1984	NONE
US	3669469 A	13/06/1972	NONE