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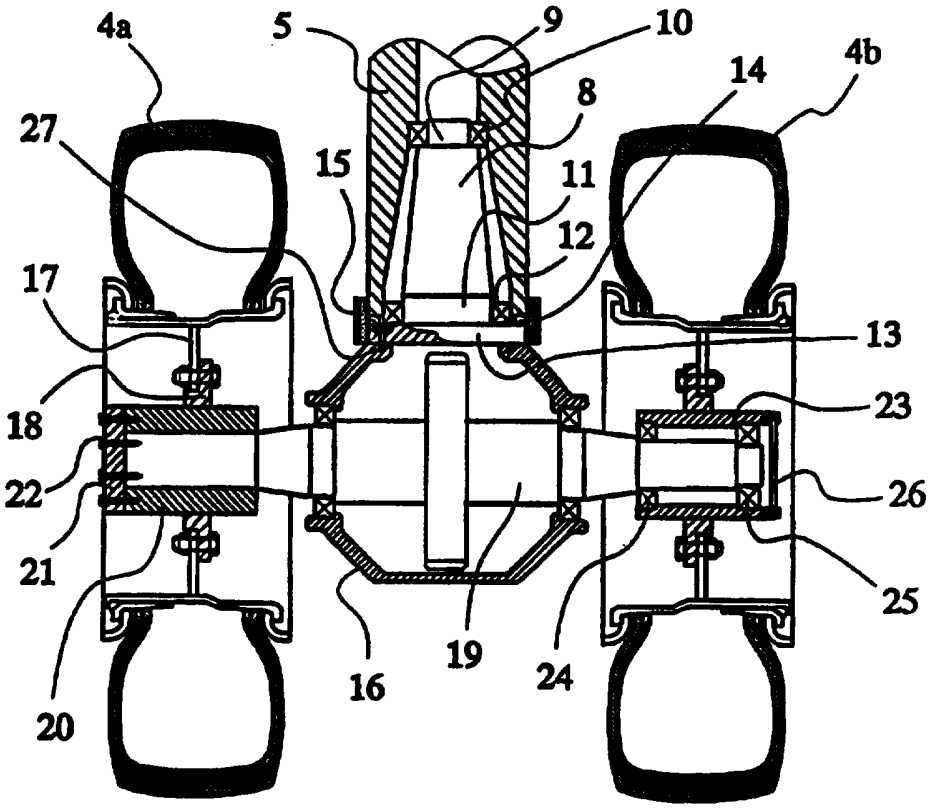
(54) Title: A METHOD AND EQUIPMENT FOR TURNING THE WHEELS OF A CRANE MOVING ON RUBBER-TYRED WHEELS OR THE LIKE

(57) Abstract

The invention relates to a method for turning a pair of wheels in a crane (1) moving on rubber-tyred wheels or the like. The crane comprises an electric motor (26) with gearing (16), the electric motor functioning as traversing gear. When the wheels of the crane are turned, the locking device (15) that prevents the wheels from turning is released, the crane is driven by the traversing gear until each pair of wheels (4) has turned to a desired angle, and the locking device (15) preventing the wheels from turning is locked. Only one of the wheels (4a) in the pair of wheels is affected by the traversing gear of the crane, the other wheel (4b) being allowed to rotate freely.



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A method and equipment for turning the wheels of a crane moving on rubber-tyred wheels or the like

The invention relates to a method defined in the preamble of claim 1 and equipment defined in the preamble of claim 3 for turning the wheels of a crane moving on rubber-tyred wheels or the like.

In prior art, a sub-chassis of a crane moving on rubber-tyred wheels comprises two large wheels one after the other, and the wheels can be turned to be parallel for lateral movement. The turning is conducted by turning the wheels to the same direction with a hydraulic cylinder or aggregate in a place specifically reserved for turning, e.g. on a marble slab. Another possibility is to lift the wheels from the ground for the duration of the turning action. Instead of two large wheels, the sub-chassis may comprise a pair of small wheels, both of which are drive wheels. Power transmission is usually implemented by open gearing with chain gears and transmission chains.

U.S. Patent 3,081,883 discloses a solution in which a sub-chassis of a crane comprises four parallel wheels, the two on the outer edges being drive wheels. The sub-chassis can be turned by operating the chain-geared traversing gears of the drive wheels to different directions.

A disadvantage of the prior art arrangement is that turning is difficult. There are only two operating positions, 0° and 90°, and it is extremely difficult, practically impossible, to steer the crane diagonally e.g. for servicing purposes. Also, because of hydraulic equipment, many components are needed, and so there are many points that may leak. Further, in chain gearing there are many points that may need servicing, and in addition chain gearing requires space.

The object of the present invention is to overcome the above disadvantages and to provide a new and advantageous solution for turning a crane moving on rubber-tyred wheels or the like. This is achieved with the method of the invention, which is characterized by what is set forth in the characterizing part of claim 1. The equipment of the invention, in turn, is characterized by what is set forth in the characterizing part of claim 3.

Other embodiments of the invention are characterized by what is set forth in the other claims.

An advantage of the invention is that the forces caused by the turning action are reversed and the crane remains stationary during the turning. Another advantage is that the wheels can be turned without any additional apparatus, such as hydraulic equipment, and the turning can be performed anywhere. Yet another advantage is that the wheels can be turned steplessly, so it is possible to move the crane diagonally or in a circle. Also, the turning does not wear the tyres notably.

In the following the invention will be described in greater detail by means of one embodiment with reference to the drawings, in which

fig. 1 shows a diagonal top view of a crane,

fig. 2 shows a shaft arrangement in one pair of wheels on a sub-chassis in the longitudinal direction of the sub-chassis,

fig. 3 shows a side view of one wheel and traversing gear of the sub-chassis,

fig. 4 shows as a top view the mutual position of a pair of wheels on a sub-chassis when the crane in steered to the lateral direction,

fig. 5 shows as a top view the mutual position of a pair of wheels on a sub-chassis when the crane in steered to the longitudinal direction, and

fig. 6 shows as a top view the mutual position of a pair of wheels on a sub-chassis when the crane in steered in a circle.

To illuminate the method, we shall first describe the structure of traversing and turning gear of the crane. Fig. 1 shows a crane 1 in which the invention is used, four sub-chassis assemblies 3 being fitted on two lower beams 2 of the frame structure at the lower corners of the crane. Each sub-chassis comprises two pairs of wheels 4 mounted in the middle of the horizontal shaft between the pair of wheels on vertical pipes 5 located at the ends of the sub-chassis such that they pivot about the vertical axis of the vertical pipe. The crane is also provided with a diesel generator 6, which supplies the crane with power, and an electric distribution unit 7. The traversing gear of the crane, which is not shown in fig. 1, is arranged in connection with the pairs of wheels 4 and comprises e.g. a secondary shaft 19, gearing 16, an electric motor 28, and a brake 29 affecting the shaft of the electric motor.

Fig. 2 shows the structure in greater detail. At both ends of the sub-chassis, a vertical pipe 5 extends downward from the sub-chassis; the pipe is hollow, and expands conically on the inside toward the bottom. At the upper end of the conical expansion there is a space for a bearing 10, and at the lower end of the expansion there is a space for a lower bearing 12. Each pair of wheels 4 is mounted on a conical hole in the vertical pipe to pivot about the vertical axis of the hole by means of a king pin 8, which comprises an upper cylindrical bearing area 9 for bearing 10 and a lower

cylindrical bearing area 11 for bearing 12. The part of the king pin between the bearing areas narrows conically toward the top, and so the diameter of bearing area 9 is smaller than that of bearing area 11. Immediately below bearing area 11 the king pin comprises a cylindrical flange 13, whose diameter is greater than that of bearing area 11. The flange provides a supporting surface for bearing 12, and the king pin is fastened at this flange to the frame of the gearing 16 between the wheels 4a and 4b in the pairs of wheels 4 with fastening bolts 27.

At the lower end of the vertical pipe 5 there is also a locking device, such as a band brake 15, affecting the lower end of the vertical pipe and the flange 13 of the king pin 8, the locking device being springdrivenly pressed against the lower end of the vertical pipe and the perimeter of the flange as the brake is in the hold position, which prohibits the vertical pipe from turning in relation to the combination of a gear box and a pair of wheels. The brake is released by means of a spindle motor (not shown in the figs.) or the like as the wheels are turned. Between the flange 13 and the lower end of the vertical pipe there is also a packing 14 that prevents the lubricant of the bearing from coming into contact with the braking area of the band brake.

The secondary shaft 19 of the gearing is mounted on the frame of the gear box 16 in an essentially horizontal position. At a first end of the shaft there is a fastening bush 20 locked in place with a wedge and encircled by a fastening flange 18 fixed to the perimeter of the bush. To prohibit axial movement, the bush 20 is also fastened to the secondary shaft 19 with bolts 22 and an end flange 21, through which the bolts 22 extend to the bush 20 and the shaft 19. On a

second end of the shaft 19 is mounted a fastening bush 23 rotating about the shaft 19. The bush is encircled by a fastening flange that is fixed to the perimeter of the flange and is identical to the fastening flange 18 at the first end. The fastening bush 23 is hollow and has on the inner surface spaces arranged to receive bearings 24 and 25 encircling the shaft 19. To prevent dirt from entering the bearings, the open end of the fastening bush 23 is sealed with a cover 26.

The drive wheel 4a in the pair of wheels 4 is fastened at its rim 17 to the fastening flange 18 with bolts 18, so that the drive wheel 4a is positively driven to rotate with the secondary shaft 19 to the same direction as the secondary shaft. Further, the free wheel 4b in the pair of wheels 4 is fastened at its rim to the fastening flange 18 with bolts, whereby the free wheel 4b rotates freely with the fastening bush 23, irrespective of the rotation of the secondary shaft. The electric motor 28, which functions as a traversing motor for the crane, is connected at one end to the gearing 16. At the other end of the electric motor there is a brake.

The method for turning a crane operates as described below. Usually, when a crane is steered to the lateral direction (direction indicated by arrow 29 in fig. 4), the pairs of wheels 4 on the sub-chassis 3 are one after the other in the longitudinal direction of the sub-chassis. The band brake 15, which functions as a locking device, is locked and although only wheels 4a operate as drive wheels, the crane moves in a straight line thanks to the locking effect of the band brake. If one wants to change the direction of travel, the band brake 15 is released, whereby the pair of wheels is able to turn about the symmetrically positioned vertical axis of the pair, the vertical axis coinciding with the

vertical axis of the vertical pipe 5 at the end of the sub-chassis and with the vertical axis of revolution of the king pin 8. A turning action takes place since only one of the wheels in the pair of wheels operates as a drive wheel, while the other is a free wheel. At one end, the pairs of wheels on both sub-chassis assemblies are arranged to turn simultaneously to opposite directions as the crane is turned, whereby the forces caused by the turning action are reversed and the crane remains stationary. As compared with the position of wheels in fig. 4, the pairs of wheels on the upper sub-chassis on the left in fig. 5 have been turned counter-clockwise (indicated by small arrows), and the pairs of wheels on the upper sub-chassis on the right have been turned clockwise (indicated by small arrows). In the lower sub-chassis assemblies of the figure, the turning directions are reversed. After the turning, the band brake 15 is locked and the crane is ready to be steered to the new direction. The turning action is performed by the traversing gear of the crane, which comprises e.g. the above-mentioned electric motor 28 and the gear box 16 with gearing.

In fig. 5, the wheels of the crane are in position for longitudinal travel (indicated by arrow 30). On a sub-chassis, the two pairs of wheels are then next to each other and not one after the other like in the embodiment above. The traversing motors 28 are here on the same side of the sub-chassis 3, whereas in the above embodiment they are in the longitudinal direction of the sub-chassis.

Fig. 6 illustrates steering in a circle (arrow 31), which is made possible by the invention. To enable steering in a circle, both pairs of wheels on a sub-chassis are turned by an angle that is dependent on the dimensions of the crane. The angle is slightly different

for the two pairs of wheels. Fig. 6 also shows that the pairs of wheels on two successive sub-chassis assemblies at one end are turned to different directions: in the figure, the pairs of wheels on the sub-chassis on the left are turned counter-clockwise, and the pairs of wheels on the sub-chassis on the right are turned clockwise. At the lower end, the turning directions of the pairs of wheels are reversed. For diagonal movement, all the wheels are always turned to the same direction.

The driving and turning action of the crane are implemented by PLC control. The secondary shaft 19 comprises a pulse detector arrangement, which calculates the turning angle of the secondary shaft, starting from a specified zeroing point. The pulse calculation information is supplied to a control circuit, which forwards it to the electric motor 28. The calculation conducted by the pulse detector arrangement shows the turning angle of the wheels, and the wheels can also be adjusted to a desired angle by this arrangement. In the positions for lateral travel shown in fig. 4 and longitudinal travel shown in fig. 5, the pulse detector arrangement comprises extra control limits that are 90 degrees apart. At the control limits, the pulse detector information is zeroed, so that the system will always know the position of the wheels. The angle of the wheels is adjusted by changing the position of a zeroing detector, which functions as a control limit and is located at a zeroing point. This is a much easier way of adjusting the angle of the wheels than the hole/pin combinations which are used in prior art systems and where the intermediate position is difficult to change.

It will be obvious to one skilled in the art that the different embodiments of the invention are not limited to the example described above but may vary within the scope of the attached claims. For example,

the traversing gear can be modified in many ways to implement the above method. Further, the forces caused by the turning action can also be reversed in the sub-chassis and not only in the end portion as described above. The two pairs of wheels on a sub-chassis thus turn simultaneously to different directions, whereby the turning forces are reversed in the sub-chassis. Another possible application is that no sub-chassis assemblies are used at all, but rather than a sub-chassis, each corner of the crane has only one pair of wheels.

Claims

1. A method for turning the wheels of a crane (1) moving on rubber-tyred wheels or the like; the wheels of the crane being arranged as pairs of wheels (4); and the crane comprising an electric motor (28) with gearing (16), which functions as traversing gear; and the wheels of the crane being turned by operating the crane by the traversing gear until each pair of wheels (4) is in the desired angle, c h a r a c - t e r i z e d in that when the wheels of the crane are turned, only one of the wheels (4a) in a pair of wheels is affected by the traversing gear, whereas the other wheel (4b) is allowed to rotate freely.

2. A method of claim 1, c h a r a c t e r - i z e d in that the crane is controlled by PLC control, so that the control system is continuously informed of the turning angle of the wheels.

3. Equipment for turning the wheels of a crane (1) moving on rubber-tyred wheels or the like; the crane comprising an electric motor (28) with gearing (16), the electric motor functioning as traversing gear; and the wheels of the crane being arranged as pairs of wheels (4), c h a r a c t e r i z e d in that the first wheel (4a) in each pair of wheels (4) is a drive wheel and the second wheel (4b) is a free wheel.

4. Equipment of claim 3, in which each pair of wheels (4) is connected with the traversing gear (16, 28) and provided with a locking device, such as a band brake (15), which prevents the pair of wheels from turning, c h a r a c t e r i z e d in that when the locking device is locked, the traversing gear moves the crane to the direction to which the wheels rotate, and that when the locking device is unlocked, the traversing gear turns the wheels to the desired position.

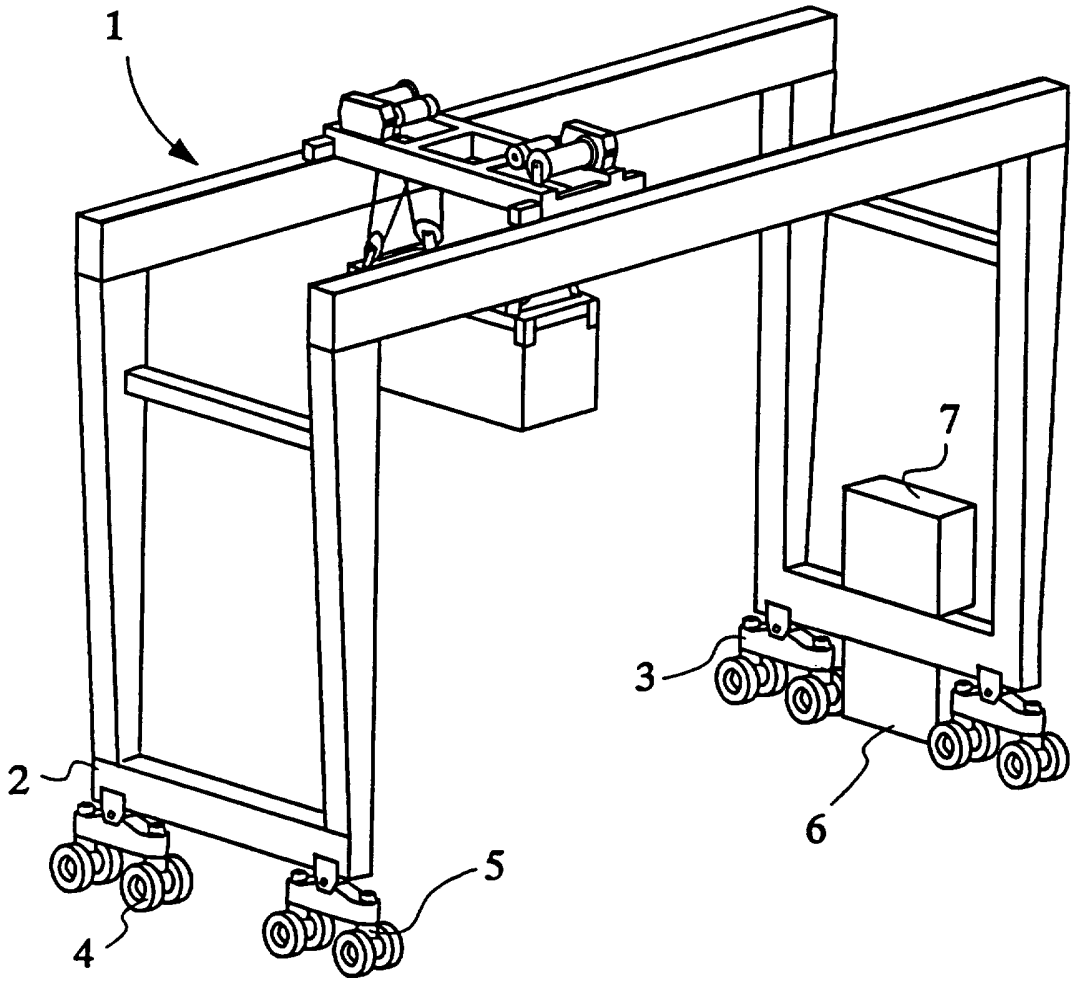

Fig. 1

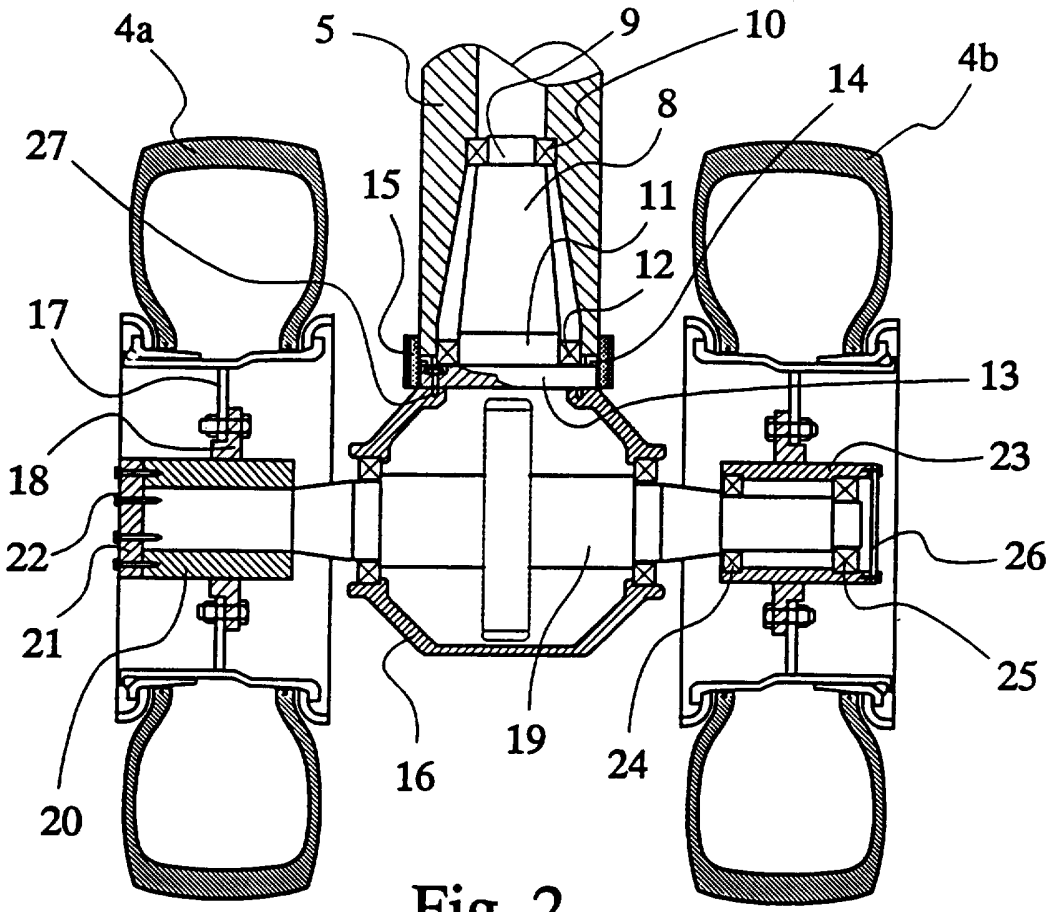
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Fig. 2

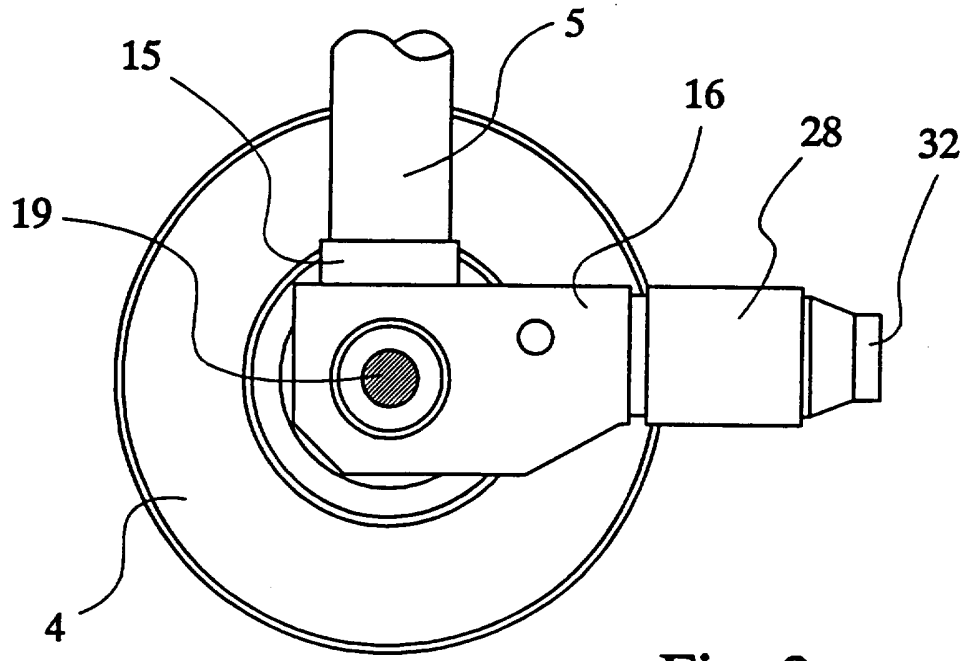
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Fig. 3

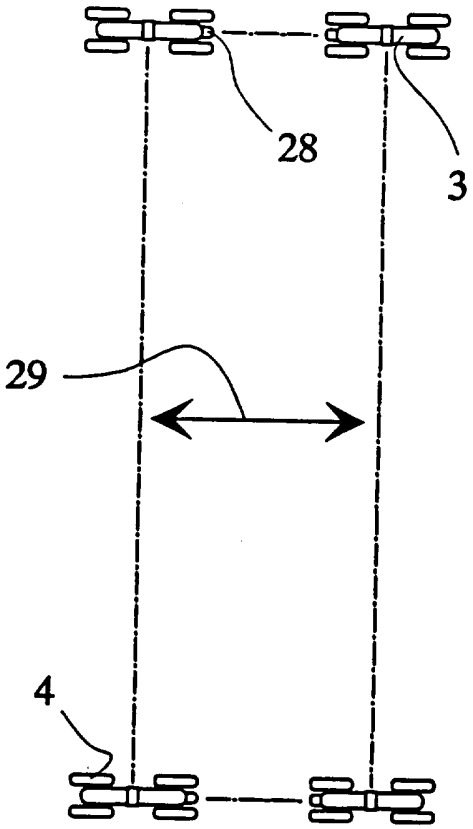


Fig. 4

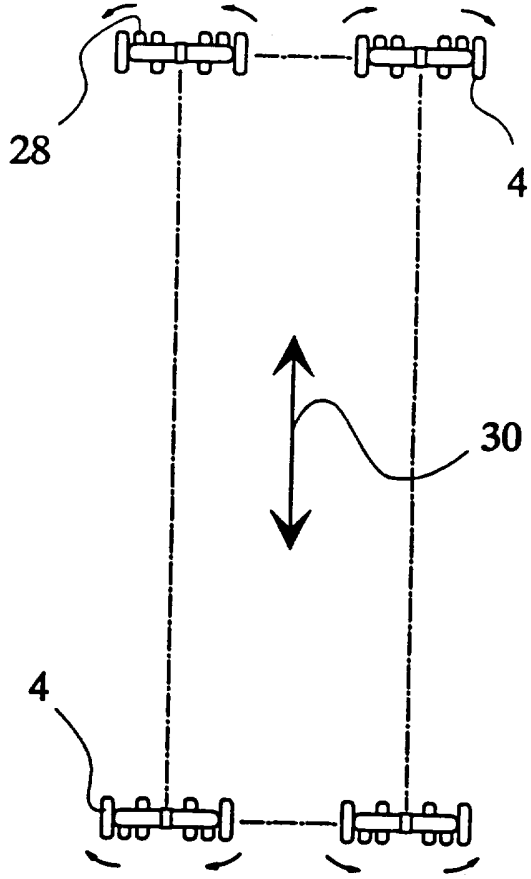
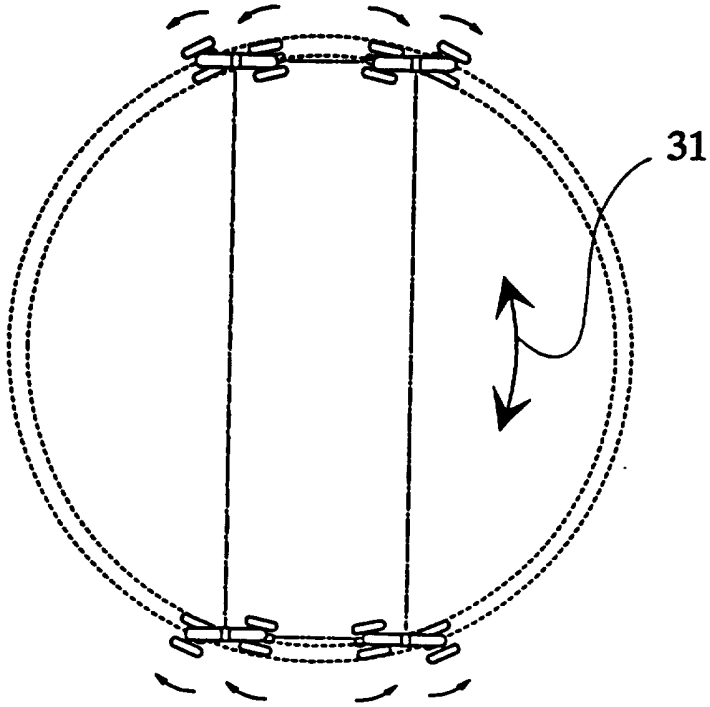


Fig. 5

Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/FI 95/00394

A. CLASSIFICATION OF SUBJECT MATTER

IPC6: B66C 9/14 // B66C 5/02
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)

IPC6: B66C

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

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 3081883 A (J.E. MINTY), 19 March 1963 (19.03.63), column 8, line 10 - line 19, figures 2, 8, claims 1,2	1,3,4
X	US 4880124 A (T. FEIDER ET AL), 14 November 1989 (14.11.89), column 6, line 19 - line 42	2

☐ Further documents are listed in the continuation of Box C. ☒ See patent family annex.

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INTERNATIONAL SEARCH REPORT

Information on patent family members

02/10/95

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3081883	19/03/63	NONE	
US-A- 4880124	14/11/89	NONE	