(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) **EP 3 412 621 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.12.2018 Bulletin 2018/50

(51) Int Cl.:
B66F 9/10 *(2006.01)*

(21) Application number: **17175047.4**

(22) Date of filing: **08.06.2017**

(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:
MA MD

(71) Applicant: **Toyota Material Handling Manufacturing Sweden AB**
595 81 Mjölby (SE)

(72) Inventor: **Lundborg, Peter**
590 49 Vikingstad (SE)

(74) Representative: **Zacco Sweden AB**
P.O. Box 5581
114 85 Stockholm (SE)

(54) **FORK-LIFT TRUCK**

(57) Fork-lift truck (1) comprising a lift module (2) and an end module (3), wherein the end module (3) and the lifting module are connected by a waist (4), wherein the waist (4) can articulate at least in a horizontal plane for manoeuvring the fork-lift truck (1) in a turn, wherein said lift module (2) comprises a mast (5) comprising a load carrier (18), which is operable to lift loads above ground level, wherein the mast (5) comprises at least one stay assembly (6) attached to the lift module (2) and the end module (3) such that they are connected to each other,, wherein the stay assembly (6) is movably connected to the lift module (2) and/or the end module (3). The invention is further related to a method of modifying a fork-lift truck (1).

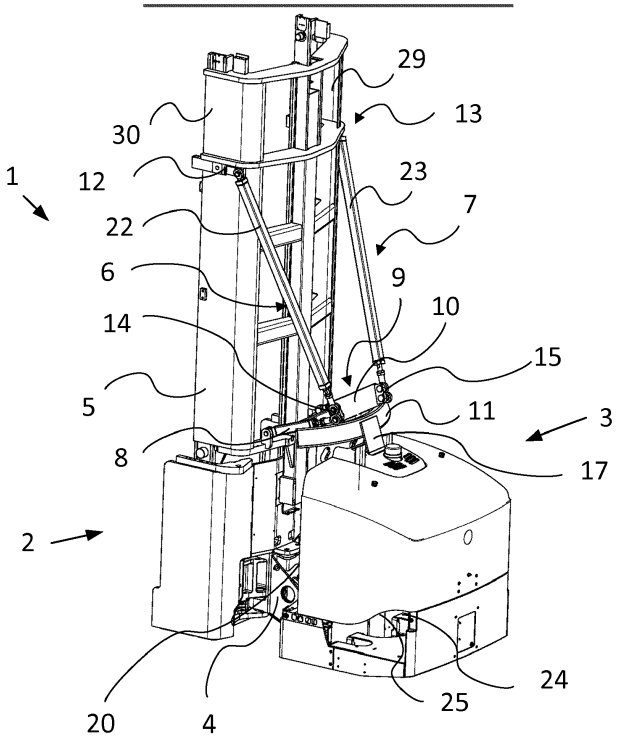

Fig. 3

EP 3 412 621 A1

Description

[0001] The present application is related to a fork-lift truck according to claim 1, and the method of modifying a fork-lift truck according to the method of claim 14.

PRIOR ART

[0002] Fork-lift trucks having a waist are used in ware houses for handling material that often is positioned in so called narrow aisles. When in the aisle the fork-lift truck is in general only operating in a forward-reverse situation. That is the changes of direction is in general linear and no turns are involved. This is often achieved by having the fork-lift truck guided by means of different guiding means that is incorporated in the floor and then detected by detectors on the fork-lift truck for controlling the direction. These narrow aisles warehouses often have very high racks of storage. Thus it is needed to be able to service these high racks, and consequently have a heavy fork-lift truck that can be stable even when the forks and also, as the case may be, the operator is order-picking at 12 meter above ground level and also advancing in the aisle with the forks and operator platform raised. Thus there is a need to have a very heavy fork-lift truck that has a low centre of gravity. When exiting the aisle the fork-lift truck needs to be able to be manoeuvrable in order to turn round corners for example to enter the next aisle, for other order pick up. This provides for a complex situation. Ideally the fork-lift truck should be low and extend both longitudinally and transversally so as to be able to be stable in both directions. However as the aisles are very narrow in order for the operator to be able to order pick from both sides of the aisle there is a limitation with regard to the transversal width of the fork-lift truck. It can be partly compensated by making the body of the fork-lift truck longer in order to introduce more weight low down. But this will make the fork-lift truck much less manoeuvrable when not in the aisle, and at the ends of the aisle. Therefore fork-lift trucks having a waist have been introduced as these can be made longer and still have good manoeuvrability when turning the fork-lift truck outside the aisles. Thus the stability has been increased without jeopardizing the manoeuvrability.

SHORT DESCRIPTION OF THE INVENTION

[0003] Nevertheless it has been determined that the fork-lift trucks having a waist will have a tendency to be less stable than the smaller fork-lift trucks without the waist, despite the fact that the smaller fork-lift trucks have a smaller mass low down in the chassis. In order to increase the stability of the fork-lift trucks having a waist it is thus suggested a fork-lift truck comprising a lift module and an end module. The end module and the lifting module are connected by a waist. The waist can articulate at least in a horizontal plane for manoeuvring the fork-lift truck in a turn. The lift module comprises a mast. The mast comprises a load carrier, which is operable to lift loads above ground level. Wherein, the mast comprises at least one stay assembly attached to the lift module and the end module. The stay assembly are attached such that the modules are connected to each other. The stay assembly is movably connected to the lift module and/or the end module.

[0004] The advantage of this fork-lift truck compared with the prior art is that it will provide a much more stable mast, despite the fact that it is inherently difficult to stabilize the mast of a fork-lift truck that is provided with a waist.

[0005] According to a further aspect of the above there is provided a fork-lift truck wherein the lift module comprises an operator cabin, preferably the operator cabin is movable in vertical direction together with the load carrier wherein the operator cabin thus allows for order picking above floor level in a ware-house.

[0006] Even though the disclosure is applicable to any fork-lift truck it is most advantageous on a large fork-lift truck that preferably has an operator's cabin that is lifted together with the load carrier. It is of extra need, for precision operation that the cabin does not swing or rock after lifting as this will slow down order picking if the operator needs to take into consideration that the mast is not stable when accessing a pallet.

[0007] According to a further aspect of the above there is suggested a fork-lift truck wherein the waist is powered, preferably by at least one hydraulic piston, such that the waist is operable for manoeuvring of the fork-lift truck by moving the end module in a horizontal plane and thus attaining an angled position compared with the lifting module in a turn.

[0008] By using the end module as a steered part of the fork-lift truck a smooth and safe manoeuvring is achieved, instead of using the end module merely as a trailer.

[0009] According to a further aspect of the above there is suggested a fork-lift truck according to any of the aspects above wherein the end module comprises a drive motor and preferably also a hydraulic pump motor.

[0010] By arranging the drive motor in the end module the balance of the fork-lift truck is improved. Also when manoeuvring the truck the fork-lift truck there is an advantage as the fork-lift truck is pushed in a turn, despite the fact that the waist will be exposed to a torque compared with a drive motor that is situated in the lifting module. That is when moving in the direction of where the load carrier of the fork-lift truck is positioned.

[0011] According to a further aspect of the above there is suggested a fork-lift truck wherein said stay assembly comprises a first roll and a rail, wherein the roll runs in the rail when the stay assembly is attached to the lift module and the end module, such that the stay assembly can keep the connection between the lift module and the end module both when moving forward and when turning.

[0012] By adding a rail and a roll the installation of the stay assembly will not impede the movements of the fork-

lift truck.

[0013] According to a further aspect of the above there is suggested a fork-lift truck the rail is attached to the end module.

[0014] By attaching the rail to the end module a very easy installation is achieved as there is no need to install a rail at height on the mast of the fork-lift truck.

[0015] According to a further aspect of the above there is suggested a fork-lift truck the rail is attached to the mast of the lifting module.

[0016] This provides for a transversally very fixed attachment as it is possible to attach the rail transversally between the two pillars of the mast.

[0017] According to a further aspect of the above there is suggested a fork-lift truck the stay assembly comprises a rod that is attached at an angle to a horizontal plane, such that the rod achieves an angle in the range of least 15 - 85 degrees with said plane, preferably at least 25-80 degrees, more preferred 30-80 degrees the angle is determined by a rod comprised in the stay assembly and the rod extend between the lifting module and the end module, preferably the roll is attached near one end of the rod.

[0018] The angled attachment provides for more stability of the mast of the lifting module, compared with for example an essentially horizontal extension of the attachment. A steeper angle provides for the possibility of stabilizing a higher mast of the fork-lift truck.

[0019] According to a further aspect of the above there is suggested a fork-lift truck the stay assembly comprises a second roll that is attached to said stay assembly, wherein the second roll is arranged to run in same rail as the first roll, preferably the second roll is attached near the same end of the rod as the first roil.

[0020] A second roll provides for an increased stabilization of the mast, despite a more complex design of the fork-lift truck. The two rolls can take up forces of twisting of the mast in a more favourable way.

[0021] According to a further aspect of the above there is suggested a fork-lift truck comprising a second stay assembly that is attached in same way as the first stay assembly to said fork-lift truck, preferably said second stay assembly uses the same rail as the first stay assembly for attachment, between the lifting module and the end module.

[0022] A second stay assembly provides for an increased stabilization of the mast, despite a more complex design of the fork-lift truck. Two stay assemblies provide for the possibility to have stabilization both to right and left of the mast. This is in particular important for the highest lifting very narrow aisle trucks that can lift up to 14 meters in the sky or higher.

[0023] According to a further aspect of the above there is suggested a fork-lift truck wherein the rail is curved, such that said roll can roll in a curved path in said rail, preferably said rail is arranged essentially horizontally such that at movement in said waist, the roll can roll when said end module moves horizontally to attains an angled configuration compared with the lifting module.

[0024] A horizontally running rail provides for easy installation and also perfect match with horizontal movement of end module of the fork-lift truck.

[0025] According to a further aspect of the above there is suggested a fork-lift truck wherein the first roll and/or the second roll, is/are attached to a plate that extend in transversal direction of the first rod and/or the second rod.

[0026] This provide for a very stable construction. In particular with two rods it gives a cage structure that can take up also torsion forces in the fork-lift truck.

[0027] According to a further aspect of the above there is suggested a fork-lift wherein the plate extend such that the first rod and the second rod are joined through said plate, preferably said first roll and/or said second roll is/are attached near middle of a side of the plate that faces the end module.

[0028] Middle mounting of either a single roll or two rolls that are positioned at equal but reversed distances around a central symmetry line of the plate, gives equal moving possibilities in both directions of turning the fork-lift truck.

[0029] According to a further aspect of the above there is suggested a method of modifying a fork-lift truck so as to produce a fork-lift truck according to any of the claims above comprising the steps of

a. providing a fork-lift truck with a lifting module and an end-module joined by a waist.

b. providing at least one stay assembly and attaching this to the lifting module and the end module such that the modules are connected, preferably the connection is achieved by means of a rail and a roll system,

said attaching is thus made such that said waist is operable after sad stay assembly is provided, to move in a horizontal plane for attaining an angled configuration between said end module and said lifting module.

[0030] The method is very advantageous as it can be used on an older fork-lift truck and thus modifies it such that the stabilisation of the mast is improved.

LIST OF FIGURES

[0031]

Figure 1 discloses a fork-lift truck according to prior art.

Figure 2 disclose a fork-lift truck according to the present disclosure.

Figure 3 discloses a further view of the fork-lift truck according to figure 2.

Figure 4 discloses a section of a stay assembly that is incorporated into a fork-lift truck according to figure

2 or 3.

Figure 5 discloses a section of a further stay assembly that can be incorporated into a fork-lift truck according to figure 2 or 3 together with stay assembly of Figure 4.

Figure 6 discloses a part of the fork-lift truck according to a preferred aspect.

Figure 7 discloses a method of modifying a fork-lift truck.

DETAILED DESCRIPTION

[0032] Figure 1 discloses a prior art fork-lift truck that has a waist. For purposes of better understanding the load carrier and the operator cabin has not been included in figure 1. In general the fork-lift truck is operated when transporting goods by lifting and lowering a load carrier that is positioned on a mast. The load carrier in general is a pair of forks that is adapted for lifting and handling a pallet. The fork-lift truck that is disclosed in figure 1 is manoeuvred by articulating the waist of in horizontal direction such that the forward, lifting module and the backward end module are essentially pointing in different directions. By manoeuvring the truck in this manner a very narrow turn radius is achieved, despite that the fork-lift truck is large and heavy. The fork-lift trucks in general comprise a drive motor and a hydraulic pump motor. The hydraulic pump motor pressurizes the hydraulic system that is mainly used for lifting operation, but also as power for other hydraulic functions of the truck. One such function is the articulation of the waist of the fork-lift truck. Forward drive is in general considered to be in the direction where the load carrier of the fork-lift is positioned. This does not mean in the direction where the load carrier is pointing, because the load carrier can be a transversal load carrier that can pick up loads in the transversal direction of the fork-lift truck. Reverse drive is in general considered driving in the direction of the fork-lift truck opposite the position of the load carrier.

[0033] Figure 2 and 3 discloses a general view of a fork-lift truck 1 according to the present disclosure. The fork-lift truck 1, has a first stay assembly 6 attached to the lift module 2 and the end module 3. The stay assembly 6 comprises a rod 22 that is attached in a point 12 to the mast 5. This rod extends 22 in the other direction to an attachment area to the end module 3. In this attachment area the rod 22 is connected to a first roll 16. The roll 16 is then attached to the end module 3, by being introduced into a rail 11. This rail 11 is attached to the end module 3, in a fixed attaching. The rail is preferred to be curved. The rail is also preferred to be attached in a horizontally curve. The roll 16 is thus preferred to have an essentially horizontal axis of rotation.

[0034] It should be understood that it is also possible to fixedly attach the rail to the lifting module 2. This is preferably achieved by attaching the rail close to the attachment point 12 of the stay assembly 6. Then the roll is attached to a rod that is attached to the end module in a fixed arrangement.

[0035] The stay assembly 6 of figure 2 and 3 is thus movably attached to the end module 3. The fork-lift truck 1, when in a turning will create an angle between the two modules 2, 3 using a waist 4. This movement is preferably performed by a hydraulic piston 20 that acts in the modules such that it can turn. The waist 4 is articulated in horizontal direction at least.

[0036] The fork-lift truck 1 comprises a load carrier 18. It is disclosed in figure 2 as a pair of forks. The position in the figure is transversal to the general longitudinal direction of the fork-lift truck 1. This is mainly a function for approaching a rack with the side of the fork-lift truck and then moving the forks in transversal direction for picking up a pallet. Other configurations are thinkable and also it is in general possible to swing the load carrier horizontally.

[0037] In general the fork-lift 1 of the present disclosure comprises an operator cabin 19. This cabin can be down cabins which at all times stay on floor level when order picking. But in more preferred for the fork-lift truck 1 of the present disclosure the operator cabin 19 is following the load carrier 18 up to the level where order picking is to be performed. This is most preferred in narrow aisle operation of the fork-lift truck 1.

[0038] The mast 5 of the fork-lift truck 1 is according the present disclosure attached to the lifting module 2 at the bottom of the mast 5. The mast 5 is further attached by means of the stay assembly 6 to the end module 3 as described above.

[0039] Further the fork-lift truck 1 of the present disclosure comprises a drive motor 24. In a preferred aspect the drive motor 24 is positioned in the end module 3. The drive motor 24 drives on or several wheels such that the fork-lift truck 1 can be run forward and backwards. The drive motor 24 is preferred to be an electric drive motor that is powered from a power source.

[0040] Further the fork-lift truck 1 of the present disclosure comprises a hydraulic pump motor 25. Preferably the hydraulic pump motor 25 is situated in the end module 3.The hydraulic pump motor drives a hydraulic pump that pressurizes the hydraulic system of the fork-lift truck 1. The hydraulic pump motor 25 is preferred to be an electric motor powered by a power source.

[0041] The power source of the fork-lift truck 1 is preferred to be a battery. The battery is most preferred to be a lead battery, but it could be also a modern lithium-ion battery or even a lithium polymer battery. It is also thinkable that the power source is a fuel cell that is supplying electricity by using hydrogen and oxygen or methane as storage sources.

[0042] The rod 22 achieves preferably an angled to a horizontal plane of 15 -85 degrees. It is preferred with 25 - 80 degrees and even more preferred 30-80 degrees. With a higher mast 5 the angle should be closer to 85

degrees than 30 degrees, around 70 degrees or so.

[0043] The stay assembly can also comprise a second roll 21 as disclosed in figure 4, and figure 6. The second roll 21 provides for a boogie attachment to the rail 11, thus being able to achieve a better stabilization function of the stay assembly 6.

[0044] In figure 3 and also figure 5, there is disclosed a second stay assembly 7. This stay assembly 7 has the same components as the first stay assembly 6. However the second stay assembly has its own components and thus provides extra stabilisation of the mast 5 compared with only using one stay assembly. The second stay assembly 7 has a consequently a second rod 23 attached at a second attachment point 13 on the mast 5. The second stay assembly further comprises at least on roll 16a and preferably a second roll 21a. However the stay assembly shares the rail 11 with the first stay assembly 6. The rolls 16, 16a of the two stay assemblies 6, 7 thus operate by rolling one after the other in the rail 11. But for a preferred aspect of the second stay assembly the rolls 16 and 21 is the same as for the first stay assembly 6. The rolls 16, 21 are then positioned in between the first stay assembly 6 and the second stay assembly 7, see figure 6.

[0045] The mast 5 in general has two large pillars 29 and 30 that are joined by transversal beams fig 3. It is preferred that the first stay assembly 6 is attached to one of the pillars 29 and 30 of the mast 5. If there is a second stay assembly 7 it is preferred that this assembly is attached to the other pillar than the first stay assembly 6. It is also possible to have a more narrow attachment at the rail than at the pillars, thus creating a transversal component of the rods direction towards the mast 5.

[0046] From figures 2-5 there is also disclosed a further attachment point between the lifting module 2 and the stay assembly 6. This further attachment point is the rod 8 that runs to a low attachment to the mast 5 of the fork-lift truck 1. This rod 8 is further connected to the rod 22 at an angle in the vicinity of the roll attachment to the rod 22. If a second attachment assembly 7 is provided there is a second rod 9 that attaches in corresponding way as rod 8, the attachment assembly 7 to a low point on the mast 5.

[0047] Figure 6 discloses a preferred aspect of part of a fork-lift truck 1. As can be seen stay assemblies 6 and 7 are present on the disclosed lifting module 2. The stay assemblies 6, 7 have a dedicated rod 22 and 23. The stay assemblies 6, 7 are attached to the mast 5 at position 12 and 13. The rods 22 and 23 extend to respective lower rods 8 and 9 also attached to the mast 5. The two rods 8, 22 and 9, 23 of each stay assembly 6, 7 meet at a joint 14 and 15. The first stay assembly 6 and the second stay assembly 7 are joined by a plate 10. The plate 10 further has a lower section 28. On the lower section 28 there are two parallel attachment points 26 and 27 for rolls 16, 21. Figure 6 discloses the rolls 16, 21 before attachment. The attachment points are in general two cylinder shaped protrusions. Figure 6 also discloses the rail 11 which is common for the two rolls 16 and 26. The rail 11 is intended to be attached to the end module 3. It should be understood that a single roll 16 is possible also. Then one of the attachment points 26, 27 can be removed.

[0048] It is in general possible to modify an older fork-lift truck 1 with the stay assembly 6 in order to achieve a fork-lift truck 1 according to the present disclosure, see figure 7.

[0049] Method of modifying a fork-lift truck 1 according to any of the aspects above comprising the steps of

a. providing a fork-lift truck 1 with a lifting module 2 and an end-module 3 joined by a waist 4.
b. providing at least one stay assembly 6 and attaching this to the lifting module 2 and the end module such that the modules are connected, preferably the connection is achieved 3 by means of a rail 11 and a roll system 16

said attaching is thus made such that said waist 4 is operable after sad stay assembly 6 is provided, to move in a horizontal plane for attaining an angled configuration between said end module 3 and said lifting module 2.

Claims

1. Fork-lift truck (1) comprising a lift module (2) and an end module (3), wherein the end module (3) and the lifting module are connected by a waist (4), wherein the waist (4) can articulate at least in a horizontal plane for manoeuvring the fork-lift truck (1) in a turn, wherein said lift module (2) comprises a mast (5) comprising a load carrier (18), which is operable to lift loads above ground level,
characterized in that
the mast (5) comprises at least one stay assembly (6) attached to the lift module (2) and the end module (3) such that they are connected to each other, wherein the stay assembly (6) is movably connected to the lift module (2) and/or the end module (3).

2. Fork-lift truck (1) according to claim 1, wherein the lift module (2) comprises an operator cabin (19), preferably the operator cabin is movable in vertical direction together with the load carrier (18) wherein the operator cabin (19) thus allows for order picking above floor level in a ware-house.

3. Fork-lift truck (1) according to claim 1 or 2, wherein the waist (4) is powered, preferably by at least one hydraulic piston (20), such that the waist (4) is operable for manoeuvring of the fork-lift truck (1) by moving the end module (3) in a horizontal plane and thus attaining an angled position compared with the lifting module (2) in a turn.

4. Fork-lift truck (1) according to any of the claims above

wherein the end module (3)comprise a drive motor (24) and preferably also a hydraulic pump motor (25).

5. Fork-lift truck (1) according to any of the claims above, wherein said stay assembly (6) comprises a first roll (16) and a rail (11), wherein the roll (16) runs in the rail (11) when the stay assembly (6) is attached to the lift module (2) and the end module (3), such that the stay assembly can keep the connection between the lift module (2) and the end module (3) both when moving forward and when turning.

6. Fork-lift truck (1) according to claim 5, wherein the rail (11) is attached to the end module (3).

7. Fork-lift truck (1) according to claim 5, wherein the rail (11) is attached to the mast (5) of the lifting module (2).

8. Fork-lift truck (1) according to any of the claims 5-7, wherein the stay assembly (6) comprises a rod (22) that is attached at an angle to a horizontal plane, such that the rod (22) achieves an angle in the range of least 15 - 85 degrees with said plane, preferably at least 25-80 degrees, more preferred 30-80 degrees, the angle is determined by a rod (22) comprised in the stay assembly and the rod (22) extend between the lifting module (2) and the end module (3), preferably the roll (16) is near one end of the rod (22).

9. Fork-lift truck (1) according to any of the claims 5-8, wherein the stay assembly (6) comprises a second roll (21) that is attached to said stay assembly (6), wherein the second roll (21) is arranged to run in same rail (11) as the first roll (16), preferably the second roll (21) is attached near the same end of the rod (22) as the first roll (16).

10. Fork-lift truck (1) according to any of the claims above, wherein the fork-lift truck (1) comprises a second stay assembly (7) that is attached in same way as the first stay assembly (6) to said fork-lift truck (1), preferably said second stay assembly (7) uses the same rail (11) as the first stay assembly (6) for attachment between the lifting module (2) and the end module (3).

11. Fork-lift truck (1) according to any of the claims 5-10, wherein said rail (11) is curved, such that said roll (16) can roll in a curved path in said rail (11), preferably said rail (11) is arranged essentially horizontally such that at movement in said waist (4), the roll (16) can roll when said end module (3) moves horizontally to attains an angled configuration compared with the lifting module (2).

12. Fork-lift truck (1) according to any of the claims 5-11, wherein the first roll 16 and/or the second roll 21, is/are attached to a plate 10 that extend in transversal direction of the first rod 22 and/or the second rod 23.

13. Fork-lift truck (1) according to claim 12, wherein the plate 10 extend such that the first rod 22 and the second rod 23 are joined through said plate, preferably said first roll 16 and/or said second roll 21 is/are attached near middle of a side of the plate 10 that faces the end module 3.

14. Method of modifying a fork-lift truck so as to produce a fork-lift truck (1) according to any of the claims above comprising the steps of

a. providing a fork-lift truck with a lifting module (2) and an end-module (3) joined by a waist (4).
b. providing at least one stay assembly (6) and attaching this to the lifting module (2) and the end module (3) such that the modules are connected, preferably the connection is achieved by means of a rail (11) and a roll system (16).

said attaching is thus made such that said waist (4) is operable after sad stay assembly (6) is provided, to move in a horizontal plane for attaining an angled configuration between said end module (3) and said lifting module (2).

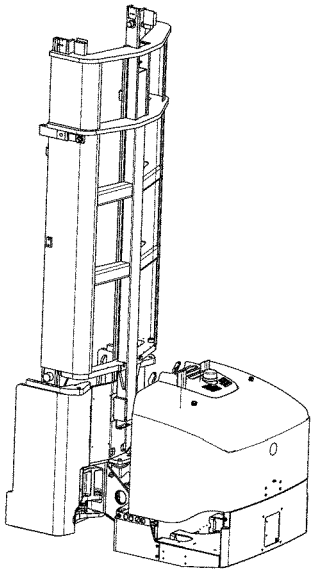

Fig. 1
(PRIOR ART)

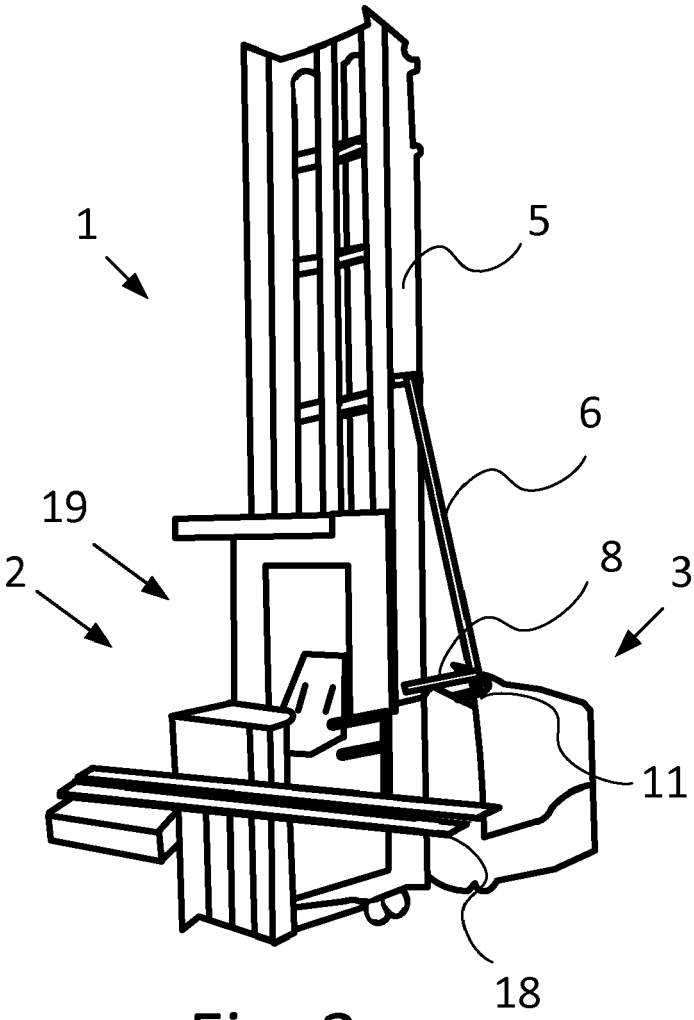

Fig. 2

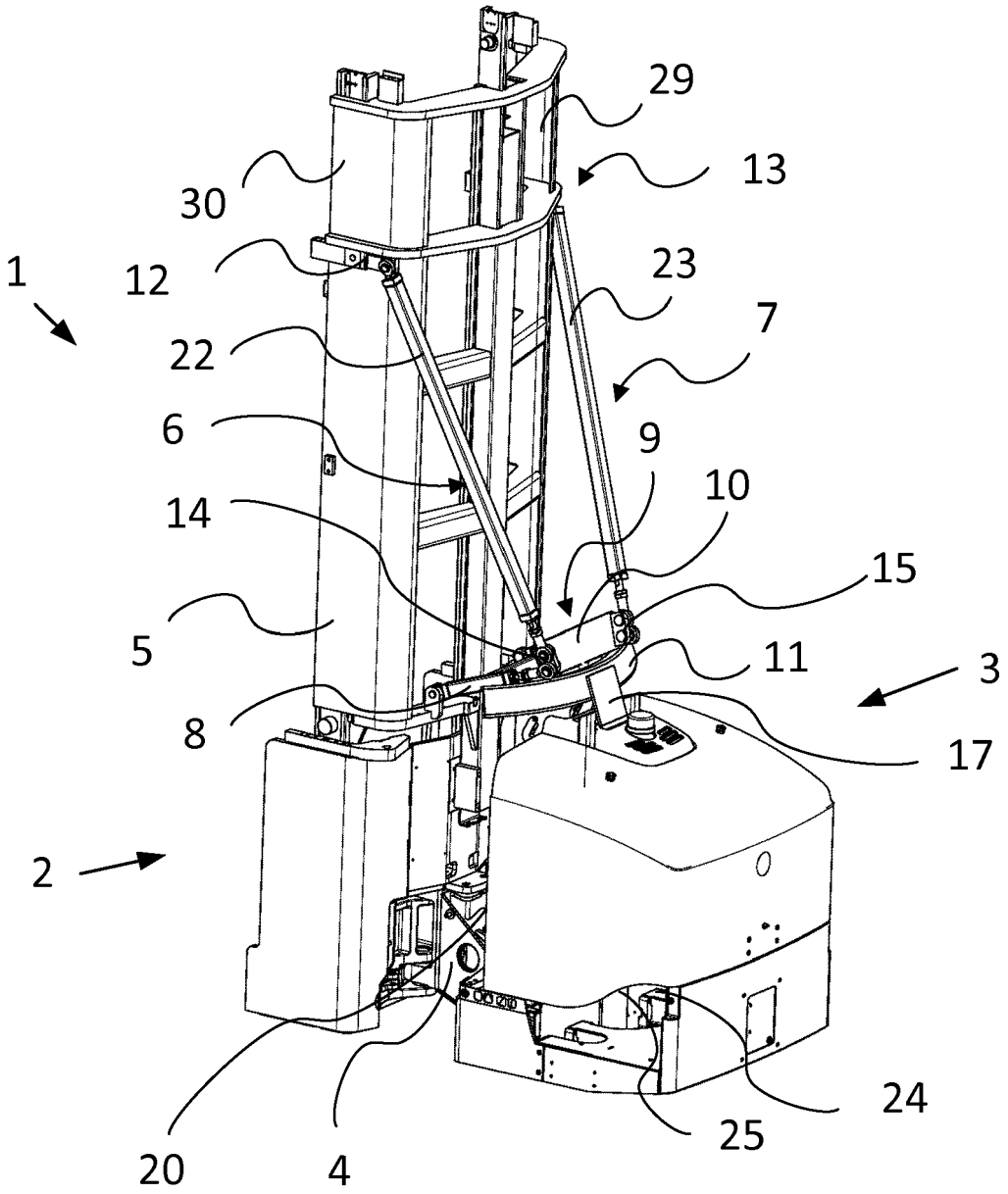

Fig. 3

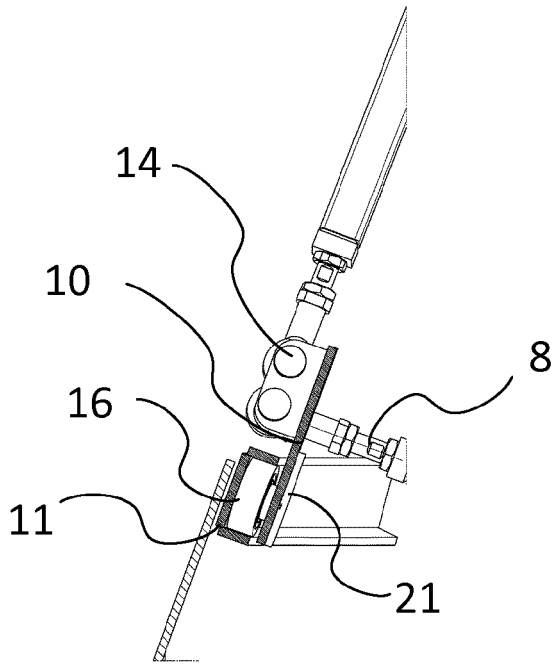

Fig. 4

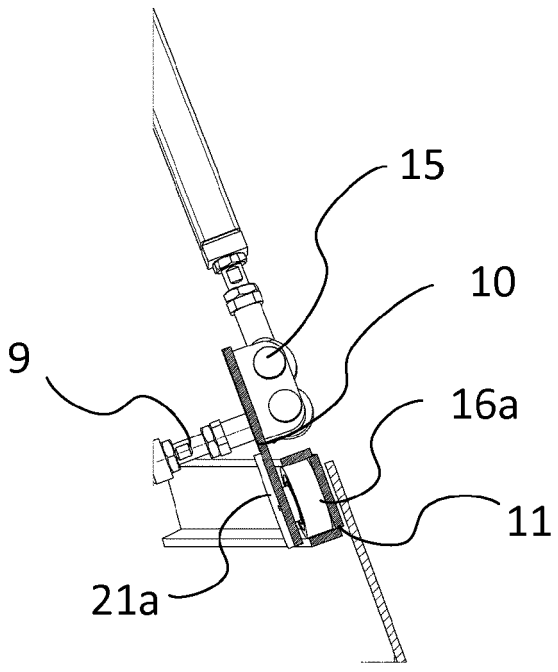

Fig. 5

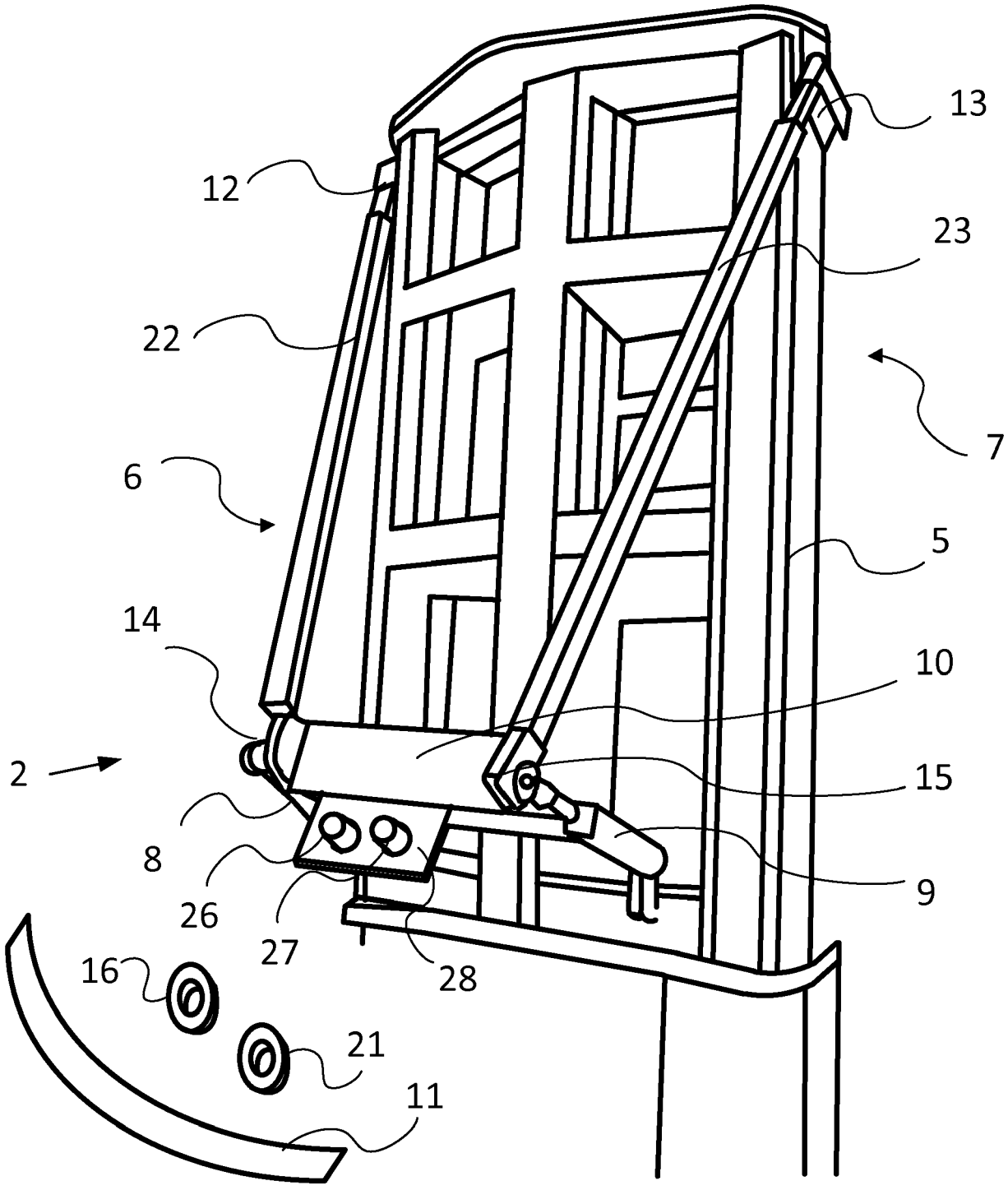

Fig. 6

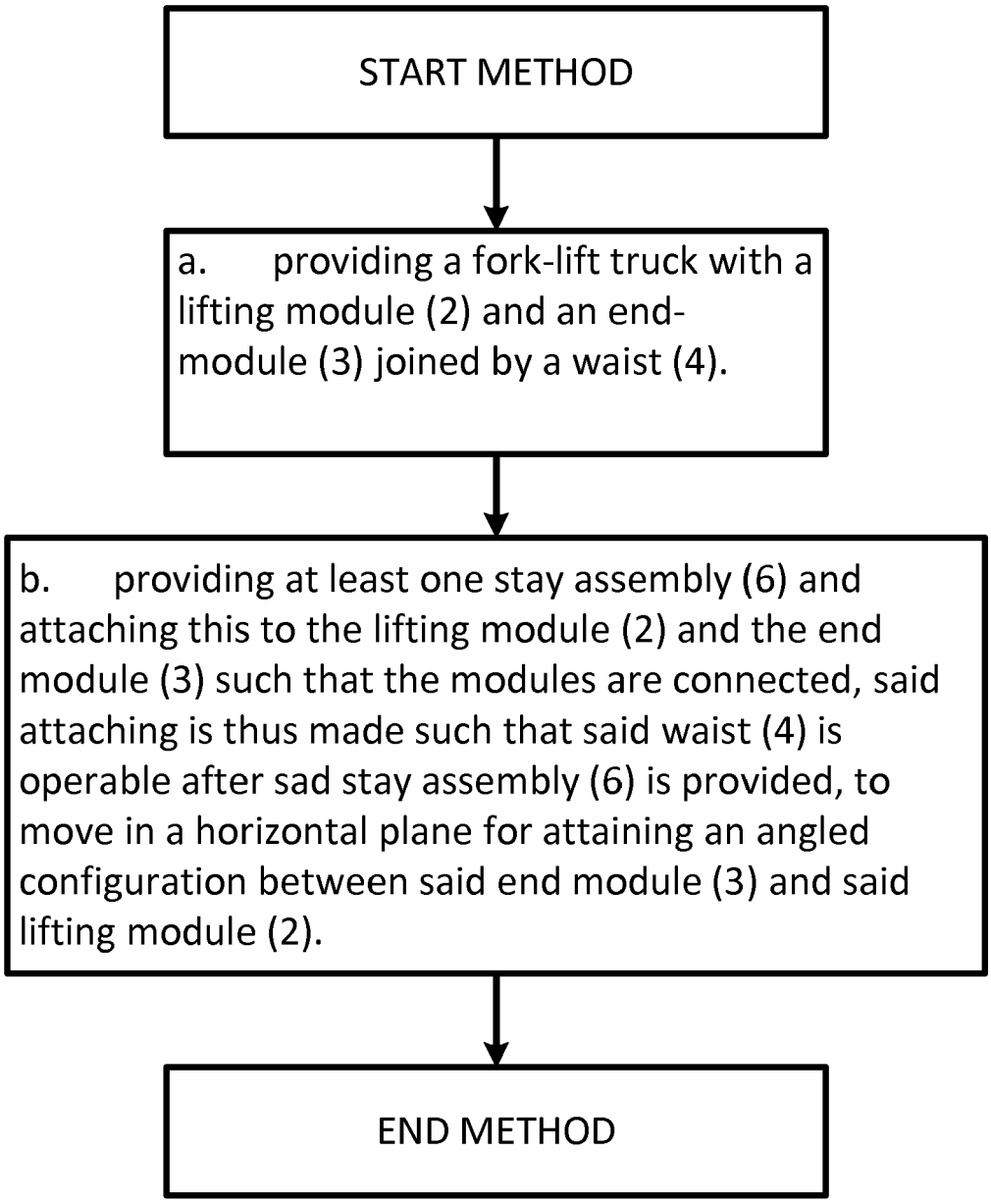
START METHOD
a. providing a fork-lift truck with a lifting module (2) and an end-module (3) joined by a waist (4).
b. providing at least one stay assembly (6) and attaching this to the lifting module (2) and the end module (3) such that the modules are connected, said attaching is thus made such that said waist (4) is operable after sad stay assembly (6) is provided, to move in a horizontal plane for attaining an angled configuration between said end module (3) and said lifting module (2).
END METHOD

Fig. 7

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 17 17 5047

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 Y	US 3 907 140 A (JINKS DAVID MARTIN) 23 September 1975 (1975-09-23) * column 1, line 1 - line 35 * * page 2, line 32 - line 64 * * figures 1-3 * -----	1-7,9, 10,14 8,11-13	INV. B66F9/10
Y A	FR 1 475 083 A (HOUGH CO FRANK) 31 March 1967 (1967-03-31) * page 1, column 1, line 1 - line 8 * * page 1, column 2, line 28 - page 2, column 1, line 5 * * page 2, column 2, line 3 - line 15 * * figures 1-2 * -----	8,13 1	
Y A	US 2 478 462 A (DECKER GARALD E) 9 August 1949 (1949-08-09) * column 3, line 13 - line 23 * * figures 1, 3, 4, 6 * -----	11,12 1	

TECHNICAL FIELDS SEARCHED (IPC)

B66F
B62D
E02F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	22 November 2017	Colletti, Roberta

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 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 17 17 5047

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.

22-11-2017

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 3907140 A	23-09-1975	GB 1423144 A	28-01-1976
		US 3907140 A	23-09-1975
FR 1475083 A	31-03-1967	NONE	
US 2478462 A	09-08-1949	NONE	

EPO FORM P0459

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