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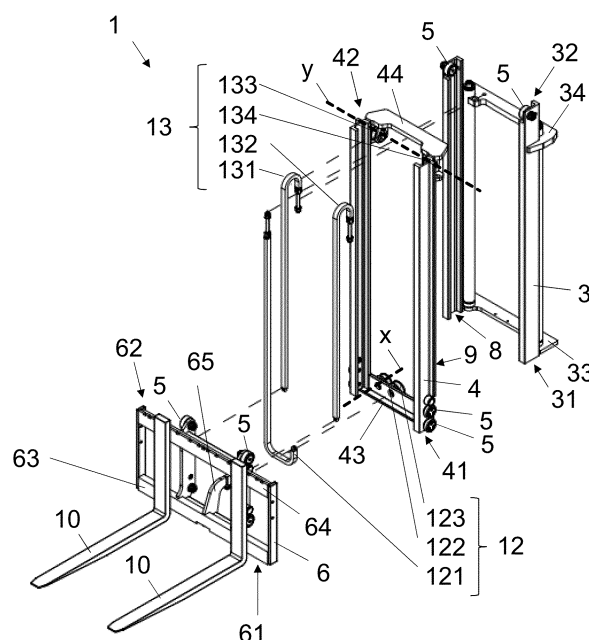
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(54) **LIFT DEVICE**

(57) Lift device (1) for a forklift (2), with
- a first frame (3) extending between a lower end (31) and an upper end (32) and
- a second frame (4) extending between a lower end (41) and an upper end (42), wherein said second frame (4) is slidably arranged on said first frame (3) and
- a fork carriage (6) extending between a lower end (61) and an upper end (62), wherein said fork carriage (6) is slidably arranged on said second frame (4), and
- with a drive unit configured to drive said sliding motion of said second frame (4) relative to said first frame (3) and said sliding motion of said fork carriage (6) relative to said second frame (4),
wherein said drive unit (11, 12, 13) comprises driving means (11) - preferably in form of at least one hydraulic jack - acting between said first frame (3) and said second frame (4) for extending and retracting said second frame (4) relative to said first frame (3), and said drive unit (11, 12, 13) further comprises a first coupling unit (12) and the second coupling unit (13) for coupling said sliding motion of said second frame (4) relative to said first frame (3) with said sliding motion of said fork carriage (6) relative to said second frame (4),
wherein said first coupling unit (12) comprises one single force transmitting coupling element (121) for coupling said sliding motion of said fork carriage (6) relative to said second frame (4) during retracting said second frame (4) relative to said first frame (3).

Fig. 2



Description

[0001] The invention concerns a lift device with the features of the preamble of claim 1 and a forklift having such a lift device.

[0002] A lift device and a forklift of such kind are well known in the art. The problem with such conventional lift devices and forklifts is that coupling units for coupling the motion of the frame of lift device of the forklift to the fork carriage of the lift device add to the overall weight and dimensions of the lift device, obstruct the view for an operator of the lift device or forklift on the forks or more specifically a load carried by the forks.

[0003] The purpose of the invention is to provide a lift device and a forklift having such a lift device in which the problems as discussed above not occur.

[0004] This is being achieved by a lift device with the features of claim 1 and a forklift having such a lift device. Embodiments of the invention are defined in the dependent claims.

[0005] As well as a conventional lift device for a forklift, the lift device of the present invention comprises a first frame extending between a lower end and an upper end, a second frame extending between a lower end and an upper end, wherein said second frame is slidably arranged on said first frame, a fork carriage extending between a lower end and an upper end, wherein said fork carriage is slidably arranged on said second frame, and a drive unit configured to drive said sliding motion of said second frame relative to said first frame and said sliding motion of said fork carriage relative to said second frame. Such a lifting device or mast is often referred to as a duplex or two stage mast.

[0006] The drive unit also comprises driving means - preferably in form of at least one hydraulic jack - acting between said first frame and said second frame for extending and retracting said second frame relative to said first frame, and said drive unit further comprises a first coupling unit and the second coupling unit for coupling said sliding motion of said second frame relative to said first frame with said sliding motion of said fork carriage relative to said second frame. A movement of the second frame relative to the first frame can thus be transferred to a movement of the fork carriage relative to the second frame. Extending the second frame relative to the first frame generally increases the length or height of the lift device, retracting the second frame relative to the first frame generally reduces the length or height of the lift device.

[0007] The second coupling unit of the lift device according to the invention further comprises one single force transmitting coupling element for coupling said sliding motion of said fork carriage relative to said second frame during retracting said second frame relative to said first frame. The coupling between the movement between the second frame and the first frame during retraction can thus be transferred to a movement of the fork carriage relative to the second frame by only one single

force transmitting coupling element. The movement of the fork carriage during retraction can be effected by the same driving means that is acting between the first frame and the second frame. The one single force transmitting coupling element adds less weight to the lift device and takes up less space, thus reducing overall weight and dimensions of the lift device, and further providing better visibility for an operator of the lift device. A single force transmitting coupling element also reduces adjustment complexity and manufacture and assembly cost.

[0008] Protection is also sought for a forklift having a lift device as described above and in the following paragraphs. Such a lift device can be built with a reduced overall weight of the forklift and improved visibility for an operator of the lift device. Both these advantages can contribute to ease and safety of operation of such a forklift. Such a forklift can be of a truck-mounted type. A lift device as described above and in the following paragraphs can be of particular advantage for use with such a truck mounted forklift, since ease of mounting the forklift to the truck can be optimized.

[0009] It can be of advantage if said coupling between said sliding motion of said fork carriage (relative to said second frame) and said sliding motion of the second frame (relative to said first frame) during retracting said second frame relative to said first frame is in the form of a purchase pulley system.

[0010] In particular, said purchase pulley system may comprise at least one pulley - preferably two pulleys - and said single force transmitting coupling element. Such a purchase pulley system is often referred to as a runner tackle (where the pulley or tackle is actively moved) or a chain roller. More specifically, said at least one pulley may be advantageously arranged nearby said lower end of said second frame, and said single force transmitting coupling element may be advantageously attached between said first frame and said fork carriage. Said single force transmitting coupling element may thus advantageously run from said first frame to said fork carriage across said at least one pulley arranged nearby said lower end of said second frame.

[0011] In connection therewith it may be of advantage if said single force transmitting coupling element is attached to said fork carriage at the lower end of said fork carriage. Such an attachment can result in overall reduced length of said single force transmitting coupling element and increase visibility for an operator of the lift device.

[0012] Further thereto, it may be of advantage if said fork carriage has a crossbeam arranged at its lower end and said single force transmitting coupling element is attached - preferably via an attachment member - to said crossbeam. Such an attachment can assure a low mounting point of the single force transmitting coupling element to the fork carriage. The attachment member may improve the attachment angle of the single force transmitting coupling element and for example allow for different sections of the single force transmitting coupling element

to be routed parallel to each other.

[0013] In particular, it may be of advantage if said single force transmitting coupling element is attached to said crossbeam substantially centrally along a length of said crossbeam. Such an attachment point can advantageously balance the forces acting upon the fork carriage via the single force transmitting coupling element. If an attachment member is employed, the attachment of said attachment member to said crossbeam may be located substantially centrally along the length of said crossbeam.

[0014] In regard to the purchase pulley system as discussed above, it may be of advantage if said second frame has a crossbeam arranged at its lower end and said at least one pulley is or are arranged on said crossbeam. This may allow for simple coupling of the relative motion of the second frame relative to the first frame and the relative motion of the fork carriage and the second frame during retracting of the second frame relative to the first frame. Said at least one pulley may be arranged on said crossbeam such that the axis of rotation of said at least one pulley is substantially perpendicular to the longitudinal extension of the crossbeam. More specifically, said at least one pulley may be arranged on said crossbeam such that the axis of rotation of said at least one pulley is substantially perpendicular to the plane of the second frame. Such an orientation of the at least one pulley may reduce overall dimensions of the lift device.

[0015] It can generally be of advantage if said one single force transmitting coupling element is single stranded. The one single force transmitting coupling element may thus be formed of a single, interconnected strand or may also be joined to a single one-stranded coupling element out of several strands joined together.

[0016] It can generally be of advantage if said one single force transmitting coupling element is provided in form of a chain. Such a chain, typically made up of several links, may be of a roller chain type or of a leaf chain type. As will be seen below, the second coupling unit of the lift device may comprise at least one further coupling element for coupling said sliding motion of said fork carriage and said sliding motion of said second frame during extending said second frame relative to said first frame, wherein said at least one further coupling element may also be provided in the form of a chain. In relation thereto, it may be advantages if said one single coupling element in form of a chain has a different gauge and/or a different chain pitch - preferably a bigger chain pitch - than the at least one further coupling element. By choosing the correct chain pitch for the one force transmitting single coupling element, the force transmission capabilities of said one coupling element can be optimized.

[0017] It can be of advantage if said second coupling unit comprises at least one force transmitting further coupling element - preferably two force transmitting further coupling elements - for coupling said sliding motion of said fork carriage (relative to the second frame) and the sliding motion of said second frame (relative to the first

frame) during extending said second frame relative to said first frame. The movement of the fork carriage during extension can be effected by the same driving means that is acting between the first frame and the second frame. For example, two further coupling elements can be provided to permit to the lifting of heavy loads. Said coupling during extension is in the form of a purchase pulley system comprising at least one pulley - preferably two pulleys - and said at least one force transmitting further coupling element, further contributing to the lift device's ability to permit the lifting of heavy loads.

[0018] It can be of advantage if said at least one pulley is or are arranged nearby an upper end of said second frame and said at least one force transmitting further coupling element is attached between said first frame and said fork carriage, and wherein said at least one force transmitting further coupling element runs from said first frame to said fork carriage across said at least one pulley arranged nearby said upper end of said first frame.

[0019] In particular, it can be of advantage if said second frame has a crossbeam arranged at its upper end and said at least one pulley is or are arranged on said crossbeam, and wherein said fork carriage has a crossbeam arranged at its upper end and said at least one force transmitting further coupling element is attached to said crossbeam. The at least one pulley and the attachment point of the at least one further coupling element can be arranged at an outer end region of said crossbeams respectively, thus not obstructing the view of an operator of the lift device. Said at least one pulley may be arranged on said crossbeam of the second frame such that the axis of rotation of said at least one pulley is substantially in a direction parallel to the longitudinal extension of the crossbeam more specifically, said at least one pulley may be arranged on said crossbeam such that the axis of rotation of said at least one pulley is substantially parallel to the plane of the second frame. Such an orientation of the at least one pulley may reduce overall dimensions, especially width, of the lift device.

[0020] Embodiments of the invention are shown in the figures, wherein:

- Fig. 1 shows different views of an embodiment of the lift device in a fully retracted state of the lift device,
- Fig. 2 shows an exploded view of the lift device in a fully retracted state of the lift device,
- Fig. 3 shows different views of an embodiment of the lift device in a partially extended state of the lift device,
- Fig. 4 shows an exploded view of the lift device in a partially extended state of the lift device,
- Fig. 5 shows different views of an embodiment of the lift device in a fully extended state of the lift device,
- Fig. 6 shows an exploded view of the lift device in a fully extended state of the lift device, and
- Fig. 7 shows a forklift having a lift device.

[0021] Figures 1, 3 and 5 show different views of an embodiment of the lift device 1 in various states of extension. Similarly, Figures 2, 4 and 6 show exploded views of an embodiment of the lift device 1 in various states of extension.

[0022] Figure 1 shows different views of an embodiment of the lift device 1 in a fully retracted state of the lift device 1. The leftmost depiction of the lift device 1 of figure 1 shows a perspective view of the lift device 1, the middle depiction shows at rear view of the lift device 1 (the same as the view an operator of the lift device 1 would be) and the rightmost depiction shows a side view of the lift device 1. In the state of the lift device 1 shown in figure 1, the second frame 4 is substantially retracted into and fully nested in the first frame 3. The fork carriage 6 is substantially in its lowermost position and is consequently located nearby the lower end 31, 32 of the first frame 3 and the second frame 4 respectively. Due to the coupling of the relative motion between the second frame 4 and the first frame 3 with the motion between the fork carriage 6 and the second frame 4 - coming from an extended state as for example shown in figure 3 - the fork carriage 6 has been pulled down into its substantially lowermost position by the one single force transmitting coupling element 121.

[0023] Figure 3 shows different views of an embodiment of the lift device 1 in a partially extended or partially retracted state of the lift device 1. The leftmost depiction of the lift device 1 of figure 1 shows a perspective view of the lift device 1, the middle depiction shows at rear view of the lift device 1 the same as the view an operator of the lift device 1 would be and the rightmost depiction shows a side view of the lift device 1. In the state of the lift device 1 shown in figure 2, the second frame 4 is partially extended relative to the first frame 3. Due to the coupling of the relative motion between the second frame 4 and the first frame 3 with the motion between the fork carriage 6 and the second frame 4, the fork carriage 6 has traveled out of its substantially lowermost position (or from its substantially uppermost position as shown in figure 5) and is consequently located between the lower end 31 of the first frame 3 and the upper end 42 of the second frame 4. Coming from the retracted state as for example shown in figure 1, the fork carriage 6 has been pulled up by the two force transmitting further coupling elements 131, 132. Coming from the extended state as for example shown in figure 5, the fork carriage 6 has been pulled down by the one single force transmitting coupling element 121.

[0024] Figure 5 shows different views of an embodiment of the lift device 1 in a fully extended state of the lift device 1. The leftmost depiction of the lift device 1 of figure 1 shows a perspective view of the lift device 1, the middle depiction shows at rear view of the lift device 1 the same as the view an operator of the lift device 1 would be and the rightmost depiction shows a side view of the lift device 1. In the state of the lift device 1 shown in figure 3, the second frame 4 is substantially maximally extend-

ed relative to the first frame 3. Coming from the partially extended state as for example shown in figure 3, the fork carriage 6 has been pulled up by the two further coupling elements 131, 132.

[0025] Figure 2 shows an exploded view of the lift device 1 which corresponds to a fully retracted state of the lift device 1.

[0026] Figure 4 shows an exploded view of the lift device 1 which corresponds to a partially extended or partially retracted state of the lift device 1.

[0027] Figure 6 shows an exploded view of the lift device 1 in a fully extended state of the lift device 1.

[0028] The lift device 1 as shown in the figures comprises a first frame 3 extending between a lower end 31 and an upper end 32, a second frame 4 extending between a lower end 41 and an upper end 42, wherein the second frame 4 is slidably arranged on the first frame 3 via bearings 5 which run in a channel 8 and against a rib 9 formed in the first frame 3 and on the second frame 4 respectively. The second frame 4 may also be provided with a channel. The lift device 1 further comprises a fork carriage 6 extending between a lower end 61 and an upper end 62, wherein the fork carriage 6 is slidably arranged on the second frame 4 via bearings 5 which run in channels 14 formed in the second frame 4. Forks 10 for lifting a load or also for attaching the forklift 2 (see figure 7) to a truck in case of the forklift to being provided in the form of a truck-mounted forklift are arranged on the fork carriage 6.

[0029] In order to drive the sliding motion of the second frame 4 relative to the first frame 3 and the sliding motion of the fork carriage 6 relative to the second frame 4, the lift device 1 further comprises a drive unit with driving means 11 (see figures 1, 3, 5 and 7), a first coupling unit 12 and a second coupling unit 13. In the embodiment shown, the driving means 11 are provided in the form of two hydraulic jacks acting between the first frame 3 and the second frame 4 for extending and retracting the second frame 4 relative to the first frame 3. The first coupling unit 12 and the second coupling unit 13 are provided for coupling the sliding motion of the second frame 4 relative to the first frame 3 with the sliding motion of the fork carriage 6 relative to the second frame 4. The first coupling unit 12 comprises one single force transmitting coupling element 121 for coupling the sliding motion of the fork carriage 6 relative to the second frame 4 during retracting the second frame 4 relative to the first frame 3.

[0030] The coupling between the sliding motion of the fork carriage 6 and the sliding motion of the second frame 4 during retracting the second frame 4 relative to the first frame 3 is provided in the form of a purchase pulley system, which is also commonly known as a chain roller, comprising two pulleys 122, 123 and the single force transmitting coupling element 121. The pulleys 122, 123 are arranged nearby the lower end 41 of the second frame 4. More specifically, the second frame 4 has a crossbeam 43 arranged at its lower end 41 and the pulleys 122, 123 are arranged on the crossbeam 43. The

place 122, 123 are both arranged on the crossbeam 43 within one of the two halves of the length of the crossbeam 43. Furthermore, the pulleys 122, 123 are arranged on the crossbeam 43 such that the axis x of rotation of the pulleys 122, 123 is substantially perpendicular to the longitudinal extension of the crossbeam 43. The single force transmitting coupling element 121 is attached between a crossbar 34 nearby the upper end 32 of the first frame 3 and the fork carriage 6, wherein the single force transmitting coupling element 121 runs from the first frame 3 to the fork carriage 6 across the pulleys 122, 123 arranged on the crossbar 43 of the second frame 4.

[0031] The single force transmitting coupling element 121 is attached to the fork carriage 6 at the lower end 61 of the fork carriage 6. More specifically, the fork carriage 6 has a crossbeam 63 arranged at its lower end 61 and the single force transmitting coupling element 121 is attached centrally to the crossbeam 63 via an attachment member 65 which is attached to the crossbeam 63 substantially centrally along a length of the crossbeam 63. In the embodiment shown, the attachment member 65 is substantially of an L-shaped profile. Other profile shapes can also be used.

[0032] The second coupling unit 13 as shown comprises two force transmitting further coupling elements 131, 132 for coupling the sliding motion of the second frame 4 and the sliding motion of the fork carriage 6 during extending the second frame 4 relative to the first frame 3. The coupling during extension is in the form of a purchase pulley system comprising two pulleys 133, 134 and the two force transmitting further coupling element 131, 132. The pulleys 133, 134 are arranged nearby an upper end 42 of the first frame 4. More specifically, the second frame 4 has a crossbeam 44 arranged at its upper end 42 and the two pulleys 133, 134 are arranged on the crossbeam 44. As shown, the pulleys 133, 134 are arranged on the crossbeam 44 of the second frame 4 such that the axis y of rotation of the pulleys 133, 134 is substantially in a direction parallel to the longitudinal extension of the crossbeam 44.

[0033] The two force transmitting further coupling elements 131, 132 are attached between the first frame 3 and the fork carriage 6. More specifically, the fork carriage 6 has a crossbeam 64 arranged at its upper end 62 and the at least one force transmitting further coupling element 131, 132 is attached to the crossbeam 64. The further coupling elements 131, 132 run from the first frame 3 to the fork carriage 6 across the two pulleys 133, 134 arranged on the crossbeam 44 of the second frame 4.

[0034] Figure 7 shows a forklift 2 having a lift device 1, which as shown is in a partially extended state. The forklift 2 can be of a truck-mounted type.

List of reference numerals:

[0035]

1 lift device

2 forklift

3 first frame

31 lower end of first frame

32 upper end of first frame

33 crossbeam

34 crossbeam

4 second frame

41 lower end of second frame

42 upper end of second frame

43 crossbeam

44 crossbeam

5 bearing

6 fork carriage

61 lower end of fork carriage

62 upper end of fork carriage

63 crossbeam

64 crossbeam

65 attachment member

8 channel in the first frame

9 channel in second frame

10 fork

11 driving means

12 coupling unit

121 coupling element

122 pulley

123 pulley

13 coupling unit

131 further coupling element

132 further coupling element

133 pulley

134 pulley

14 channel in the second frame

x axis of rotation

y axis of rotation

Claims

1. Lift device (1) for a forklift (2), with

- a first frame (3) extending between a lower end (31) and an upper end (32) and
- a second frame (4) extending between a lower end (41) and an upper end (42), wherein said second frame (4) is slidably arranged on said

first frame (3) and

- a fork carriage (6) extending between a lower end (61) and an upper end (62), wherein said fork carriage (6) is slidably arranged on said second frame (4), and
- with a drive unit configured to drive said sliding motion of said second frame (4) relative to said first frame (3) and said sliding motion of said fork carriage (6) relative to said second frame (4),

wherein said drive unit (11, 12, 13) comprises driving means (11) - preferably in form of at least one hydraulic jack - acting between said first frame (3) and said second frame (4) for extending and retracting said second frame (4) relative to said first frame (3), and said drive unit (11, 12, 13) further comprises a first coupling unit (12) and the second coupling unit (13) for coupling said sliding motion of said second frame (4) relative to said first frame (3) with said sliding motion of said fork carriage (6) relative to said second frame (4),

characterized in that said first coupling unit (12) comprises one single force transmitting coupling element (121) for coupling said sliding motion of said fork carriage (6) relative to said second frame (4) during retracting said second frame (4) relative to said first frame (3).

2. Lift device according to the preceding claim, wherein said coupling between said sliding motion of said fork carriage (6) and said sliding motion of the second frame (4) during retracting said second frame (4) relative to said first frame (3) is in the form of a purchase pulley system (121, 122, 123).
3. Lift device according to the preceding claim, wherein said purchase pulley system (121, 122, 123) comprises at least one pulley (122, 123) - preferably two pulleys (122, 123) - and said single force transmitting coupling element (121).
4. Lift device according to the preceding claim, wherein said at least one pulley (122, 123) is or are arranged nearby said lower end (41) of said second frame (4) and said single force transmitting coupling element (121) is attached between said first frame (3) and said fork carriage (6), and wherein said single force transmitting coupling element (121) runs from said first frame (3) to said fork carriage (6) across said at least one pulley (122, 123) arranged nearby said lower end (41) of said second frame (4).
5. Lift device according to the preceding claim, wherein said single force transmitting coupling element (121) is attached to said fork carriage (6) at the lower end (61) of said fork carriage (6).
6. Lift device according to one of the two preceding

claims, wherein said fork carriage (6) has a crossbeam (63) arranged at its lower end (61) and said single force transmitting coupling element (121) is attached - preferably via an attachment member (65) - to said crossbeam (63).

7. Lift device according to the preceding claim, wherein said single force transmitting coupling element (121) is attached to said crossbeam (63) substantially centrally along a length of said crossbeam (63).
8. Lift device according to one of the preceding claims 4 to 7, wherein said second frame (4) has a crossbeam (43) arranged at its lower end (41) and said at least one pulley (122, 123) is or are arranged on said crossbeam (43).
9. Lift device according to at least one of the preceding claims, wherein said one single force transmitting coupling element (121) is single stranded.
10. Lift device according to at least one of the preceding claims, wherein said one single force transmitting coupling element (121) is provided in form of a chain.
11. Lift device according to at least one of the preceding claims, wherein said second coupling unit (13) comprises at least one - preferably two - force transmitting further coupling elements (131, 132) for coupling said sliding motion of said second frame (4) and said sliding motion of said fork carriage (6) during extending said second frame (4) relative to said first frame (3), wherein said coupling during extension is in the form of a purchase pulley system comprising at least one pulley (133, 134) - preferably two pulleys (133, 134) - and said at least one force transmitting further coupling element (131, 132).
12. Lift device according to the preceding claim, wherein said at least one pulley (133, 134) is or are arranged nearby an upper end (42) of said second frame (4) and said at least one force transmitting further coupling element (131, 132) is attached between said first frame (3) and said fork carriage (6), and wherein said at least one force transmitting further coupling element (131, 132) runs from said first frame (3) to said fork carriage (6) across said at least one pulley (133, 134) arranged nearby said upper end (42) of said first frame (4).
13. Lift device according to the preceding claim, wherein said second frame (4) has a crossbeam (43) arranged at its upper end (42) and said at least one pulley (133, 134) is or are arranged on said crossbeam (43), and wherein said fork carriage (6) has a crossbeam (64) arranged at its upper end (62) and said at least one force transmitting further coupling element (131, 132) is attached to said crossbeam

(64).

14. Forklift (2), having a lift device (1) according to at least one of the preceding claims.

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15. Forklift according to the preceding claim, wherein said forklift (1) is a truck-mounted forklift (2).

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Fig. 1

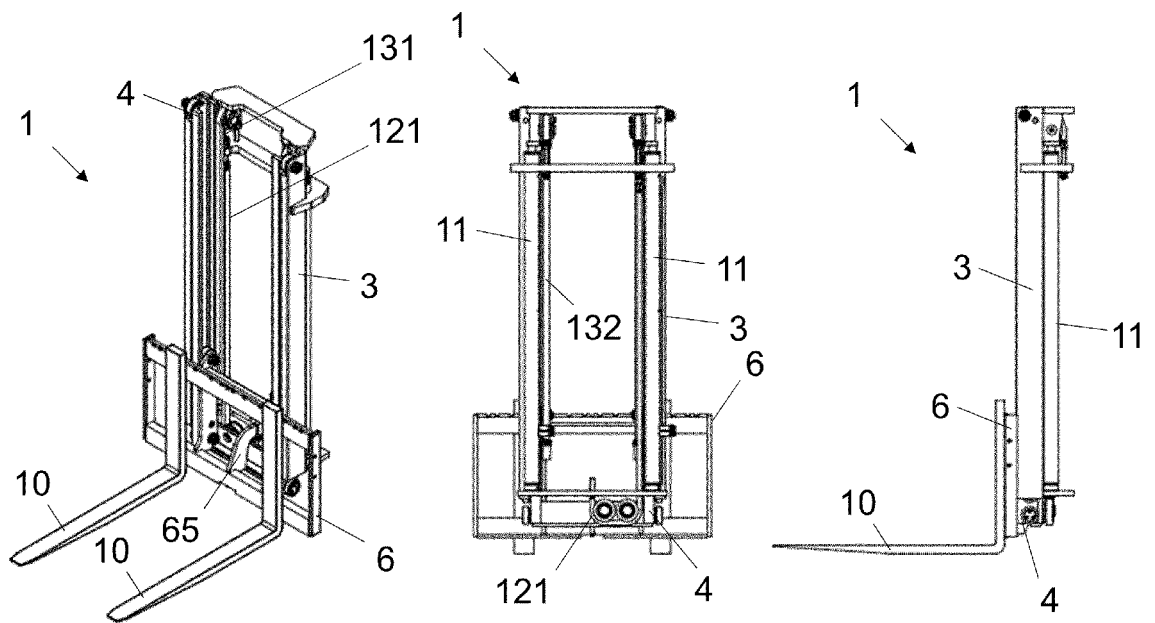


Fig. 2

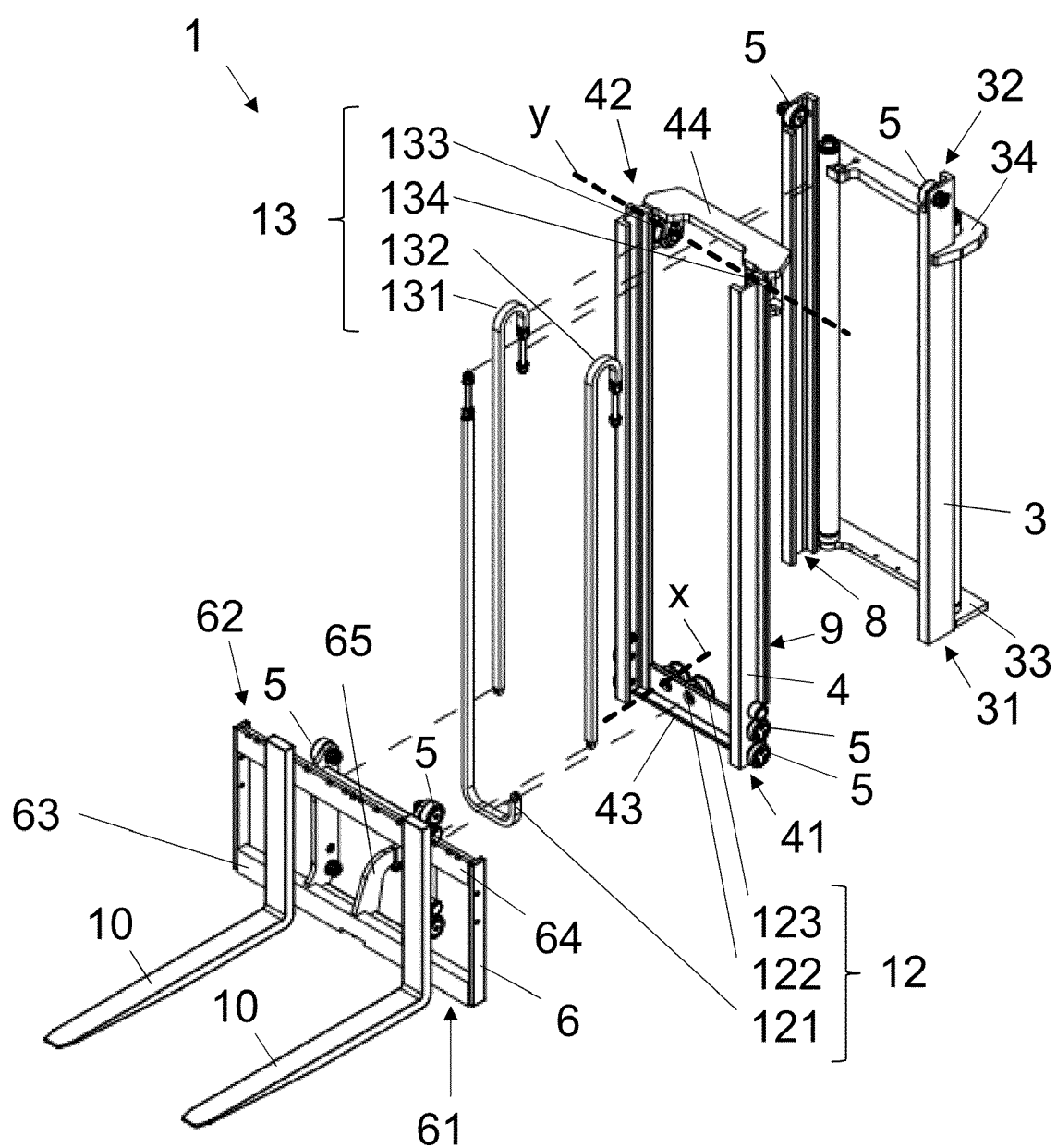


Fig. 3

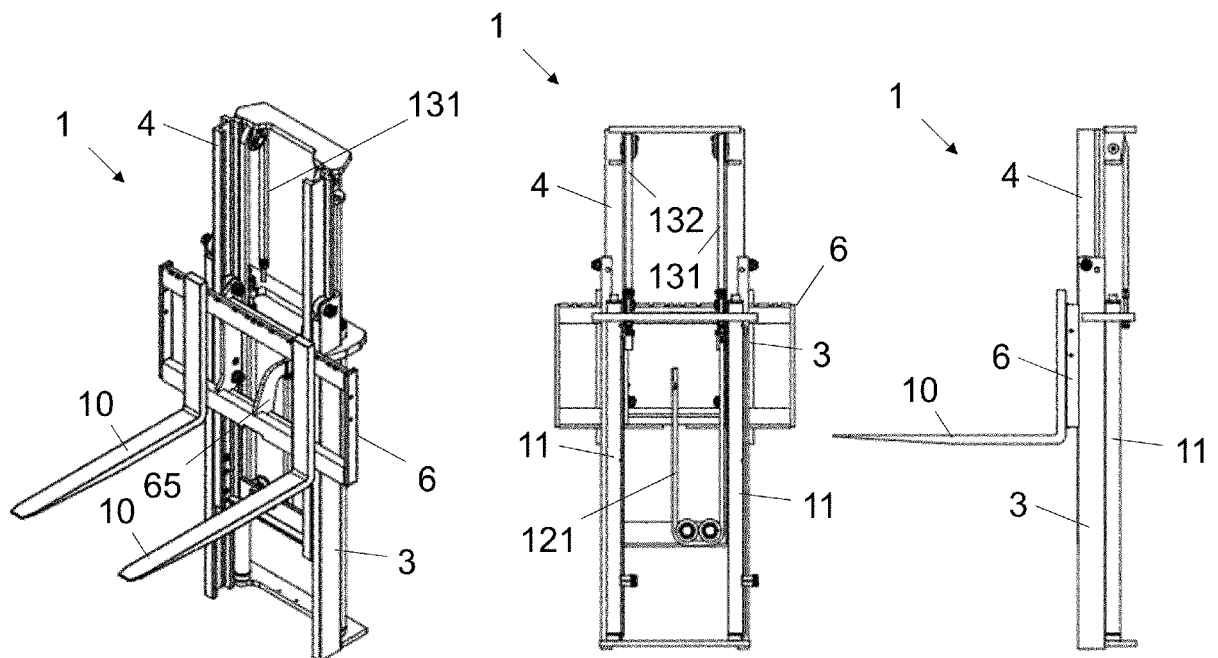


Fig. 4

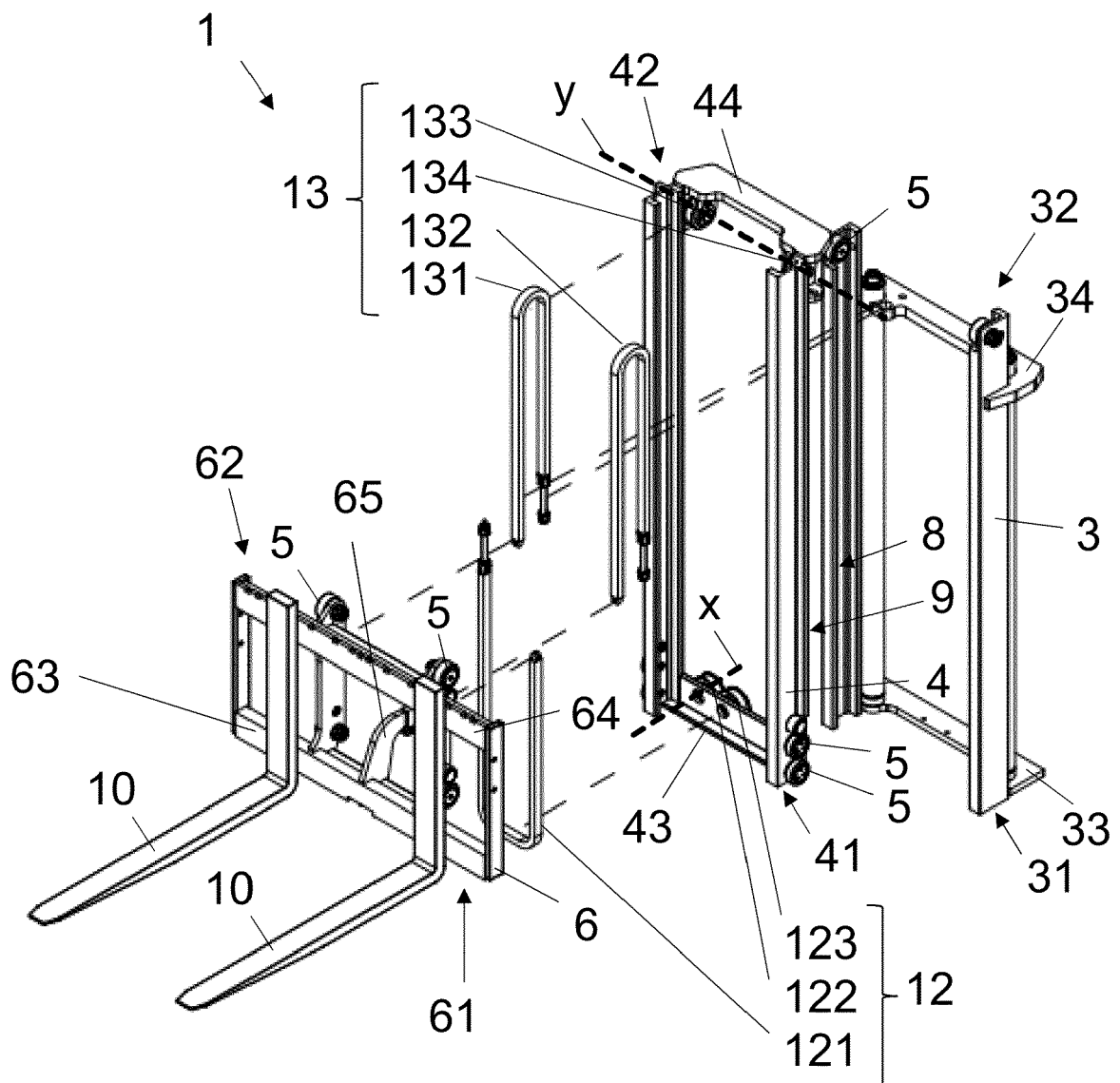


Fig. 5

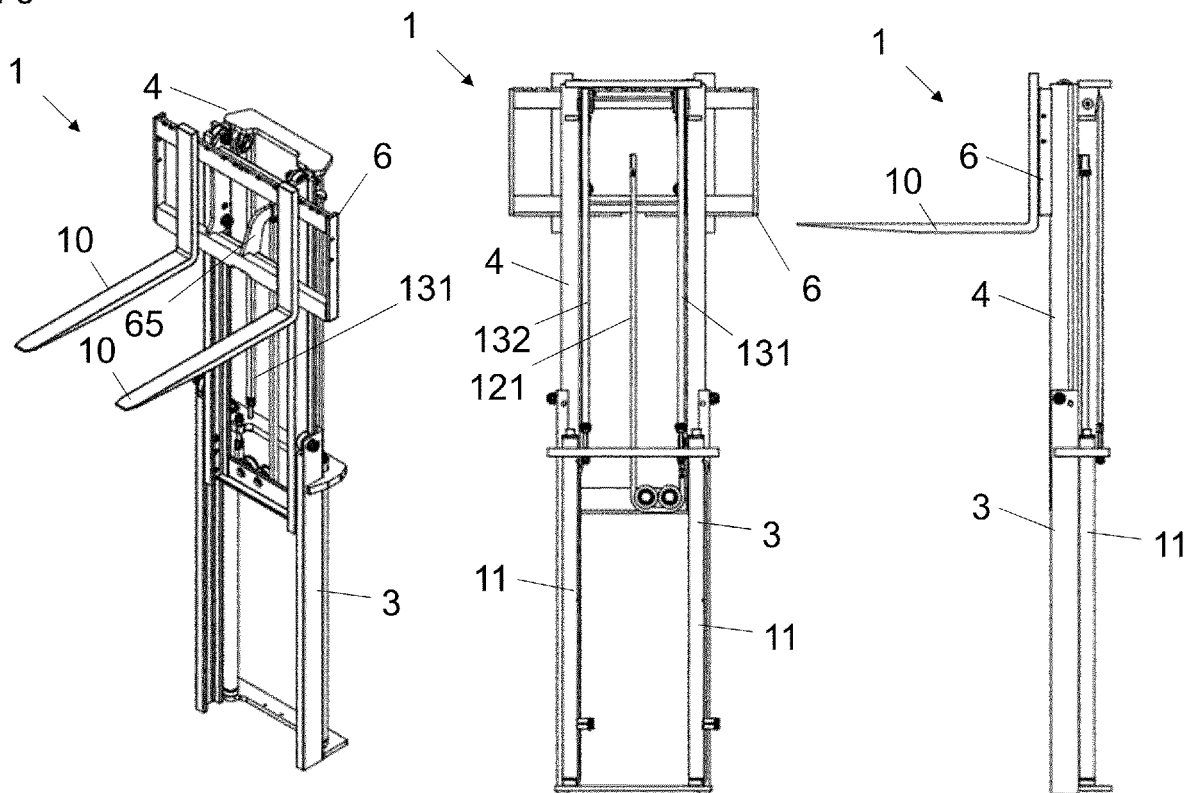


Fig. 6

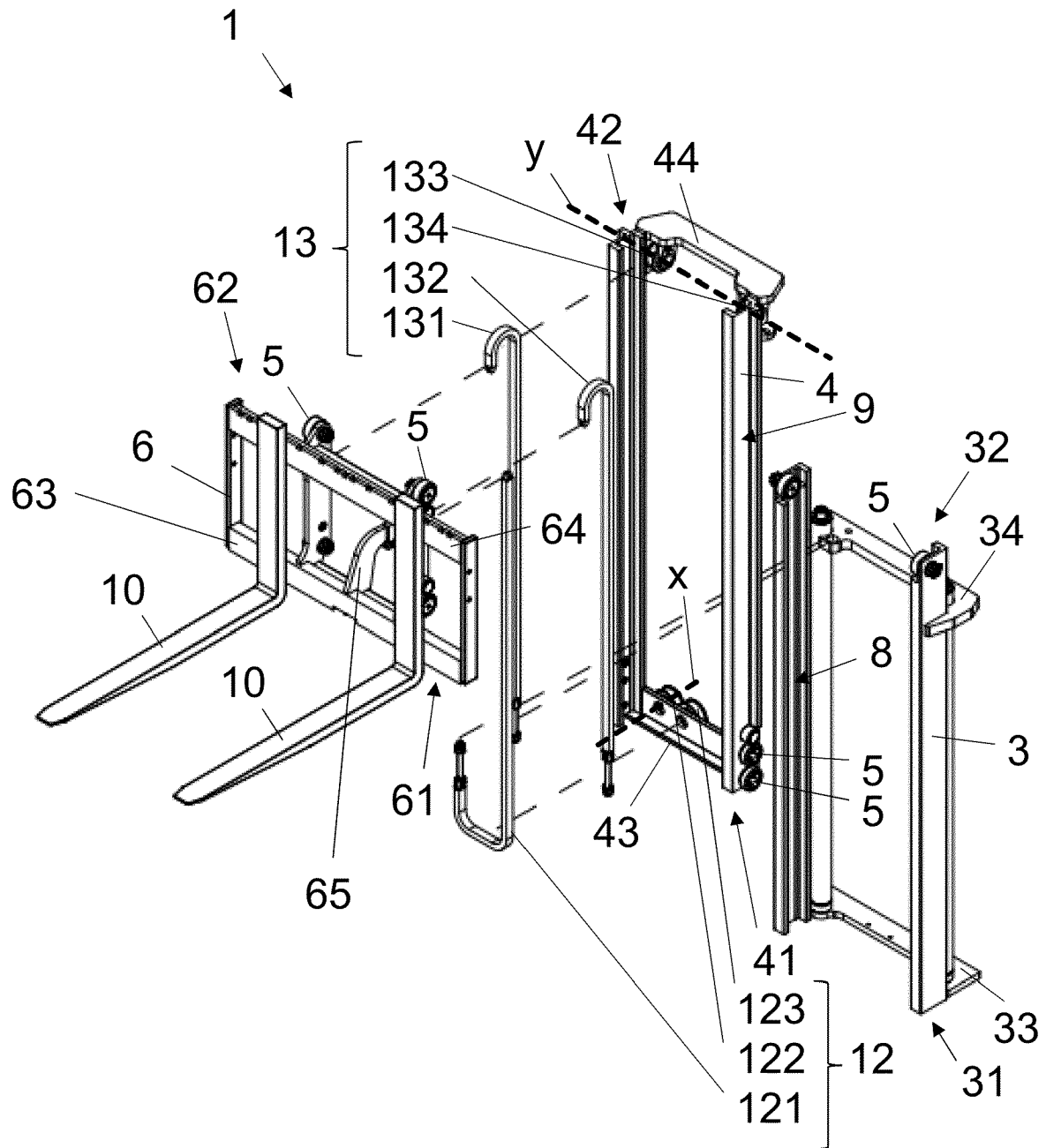
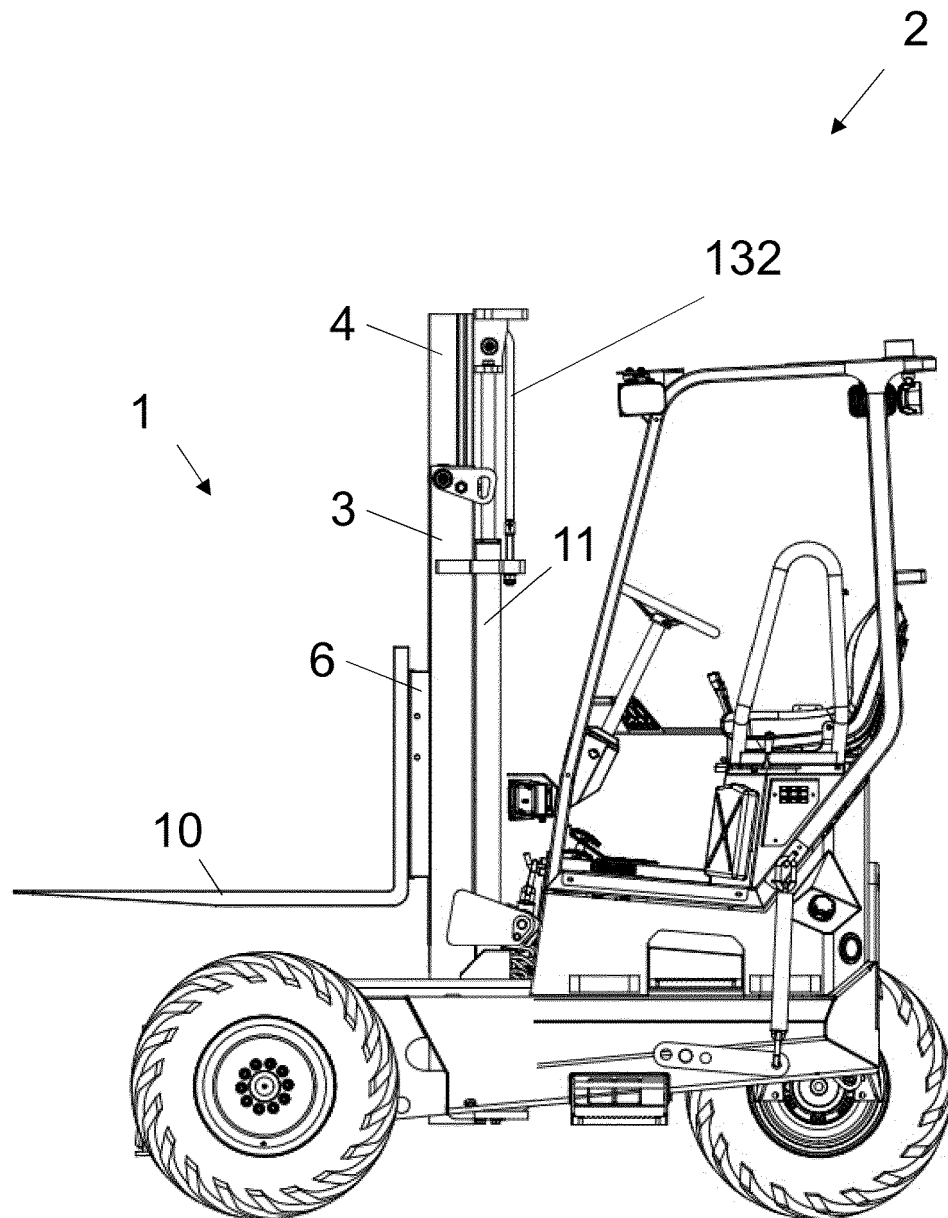


Fig. 7





EUROPEAN SEARCH REPORT

Application Number
EP 17 18 9036

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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	JP H03 23199 U (N.A.) 11 March 1991 (1991-03-11) * the whole document * -----	1-15	INV. B66F9/08
			TECHNICAL FIELDS SEARCHED (IPC)
			B66F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 20 February 2018	Examiner Serôdio, Renato
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			

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EPO FORM 1503 03/82 (P04C01)

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

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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
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