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(54) LIFTING DEVICE AND METHOD OF USING IT

(57) This invention relates to a lifting device and a method of using it, the lifting device comprising a lifting mechanism, which lifting device is arranged to be moved by means of its own lifting mechanism from a lower plane to an upper plane and vice versa, which lifting device further comprises a frame (1, 1a) , a main wheel (3) connected to the frame, a pair of support arms (4) arranged to be moved relative to the frame, each of which support arm (4) comprising a support wheel (5) at its free end, and a lifting carriage (7) equipped with a pair of lifting forks (8). The lifting device comprises a pair of auxiliary supporting mechanisms (6) with height-adjustable auxiliary supporting wheels (9) to support the lifting device on the upper plane.

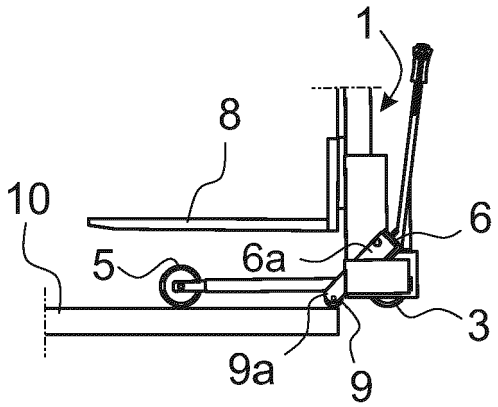

Fig. 8

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Description

[0001] The present invention relates to a lifting device as defined in the preamble of claim 1 and a method of using said lifting device as defined in the preamble of claim 10.

[0002] In connection with goods transport, loading and unloading, loads have to be moved, for example, from warehouses to a transport vehicle and from the transport vehicle to the place of use or, for example, to a temporary storage. In case the transport vehicle is a van or a small truck, they usually do not have a tail lift or a similar device for cost reasons, in which case the load must be lifted onto and off the platform of the transport vehicle with the help of a separate lifting and transfer device. In this case, for example, a pallet jack or a similar lifting and transfer device can be used. When using ordinary pallet jacks or similar devices the problem is how to carry the load further on the platform at an upper level. On the platform another pallet jack or alike is also needed.

[0003] A solution to the problem mentioned above is presented in EP patent no. EP0553086 B1, which is considered to be the closest prior art to the present solution. In the solution of the EP patent a self-elevating forklift truck is presented. The device can be raised onto the platform of the transport vehicle or another upper plane with its own lifting mechanism, after which the device and its load can be moved on this platform. This is possible thanks to the four small carrier wheels, which can be pushed inside the lifting forks raised on the platform, and after raising the lifting forks the device with the load can be moved on the platform. However, due to the small carrier wheels, the ground clearance of the EP solution is small, and that is why it is difficult to move the load along the ground on uneven surfaces having, for example, bumps, rails or low ramps and thresholds. For that reason, the EP device needs additional wheels with bigger diameter.

[0004] The US patent No. US4061237 presents a motor driven forklift truck which is capable of ascending to about the level of the loading platform of a vehicle. This forklift truck is specially adapted only to be stored at the rear end of the platform of the transport vehicle for transporting it to other locations and operating it there as an ordinary mobile forklift truck. For raising and locking the forklift truck of the US patent at its transport location in the transport vehicle the platform comprises special stirrups and a support arm to carry the forklift truck protruding over the rear edge of the loading platform of the transport vehicle. The forklift truck according to the US patent also comprises auxiliary support wheels which are turned onto the ground before the forklift truck is raised onto its transport location. The auxiliary support wheels are not used on the platform of the transport vehicle. The forklift truck according to the US patent cannot raise itself to move on the platform of the transport vehicle.

[0005] Yet another prior art solution related to self-lifting forklift trucks is presented in US patent No. US4460064. As additional wheels this solution comprises small retractable support wheels installed under the forks and larger ground engaging wheels at the back section of the device. The auxiliary support wheels support the forks and a load in front of the device and the ground engaging wheels support the device behind a driver who sits inside the device. When the body of the device is raised upwards the ground engaging wheels extend downward and support the body of device from behind. When the main wheels touch the surface of the platform the ground engaging wheels can be raised up and the device can be driven deeper on the platform of the transport vehicle. The solution of US4460064 is very complicated and tall. Also, auxiliary support wheels under the forks are very vulnerable, particularly because they are not visible all the time.

[0006] The object of the present invention is to eliminate the above-mentioned disadvantages and to provide a simple, inexpensive, safe and easy to handle, and at the same time a reliably functioning lifting device and method of using the lifting device. The lifting device according to the present invention is characterized by what is presented in the characterization part of claim 1, and the method of using the lifting device is characterized by what is presented in the characterization part of claim 10. Other embodiments of the invention are characterized by what is presented in the other claims.

[0007] An aspect of the invention is to provide a lifting device which comprises a lifting mechanism, which lifting device is arranged to be moved by means of its own lifting mechanism from a lower plane to an upper plane and vice versa, which lifting device further comprises a frame, a main wheel connected to the frame, a pair of support arms arranged to be moved relative to the frame, each of which support arm comprising a support wheel at its free end, and a lifting carriage equipped with a pair of lifting forks. Advantageously, the lifting device comprises a pair of auxiliary supporting mechanisms with height-adjustable auxiliary supporting wheels to support the lifting device on the upper plane.

[0008] Another aspect of the invention is to provide a method of using the lifting device, which lifting device comprises a frame, a main wheel connected to the frame, a pair of support arms arranged to be moved relative to the frame, each of which support arm comprising a support wheel at its free end, and a lifting mechanism with a lifting carriage equipped with a pair of lifting forks, which lifting device is moved by means of its own lifting mechanism from a lower plane to an upper plane and vice versa. Advantageously, when moving the lifting device between the two planes at different heights, the auxiliary support wheels are lowered against the upper plane for supporting the movement of the lifting device on the upper plane.

[0009] The solution of the invention has significant advantages over the solutions of the prior art. Among other things, thanks to larger main wheels the ground clearance of lifting device is relatively big. That helps to

use it in the areas where the ground is not substantially flat and even. Another advantage is ideally situated auxiliary support wheels that support the load and the lifting device when the device is driven onto the platform of the transport vehicle. Yet another advantage is the motor drive of the auxiliary support wheels, which makes it possible to transfer even heavy loads on the platform of the transport vehicle.

[0010] In the following, the invention will be described in detail by the aid of examples by referring to the attached simplified and diagrammatic drawings, wherein

Fig. 1 presents a side view of a lifting device according to the invention,

Fig. 2 presents a top view of a lifting device according to Fig.1,

Figs. 3-11 present in a side view the phases of raising the lifting device according to Fig. 1 from the ground onto the platform of a transport vehicle, and

Fig. 12 presents an enlarged side view of a safety mechanism of the lifting device according to Fig.1.

[0011] Fig. 1 presents in a side view a lifting device according to the invention, and Fig. 2 presents the same lifting device in a top view. The lifting device comprises an upright frame 1, a horizontal frame 1a in the lower part of the upright frame 1, a machinery unit 2 in connection with the upright frame 1 and/or with horizontal frame 1a, and a steerable first wheel 3 or main wheel below the upright frame 1 and substantially in the center of the horizontal frame 1a. The lifting device comprises also a control bar 2a to steer the lifting device by turning the main wheel 3 and to control the motions of the lifting device. The lifting device also comprises a driving machinery to rotate the main wheel 3.

[0012] For lifting and lowering loads the lifting device is equipped with a lifting mechanism which comprises a carriage 7 which is placed partially inside the upright frame 1 to be moved guided up and down. The carriage 7 further comprises at its lower part two parallel lifting forks 8 which extend forward from the upright frame 1.

[0013] In addition, the lifting device comprises two parallel horizontal support arms 4 equipped with an idler wheel 5 at the front end or free end of each support arm 4. At their rear ends the support arms 4 are installed slidably at each end of the horizontal frame 1a to be moved in the perpendicular direction back and forth through the horizontal frame 1a. Each support arm 4 is essentially straight and can be pulled and pushed linearly through the horizontal frame 1a.

[0014] Each support arm 4 is guided at its rear end through the horizontal frame 1a by a guide member having preferably a square cross-section, such as a square tube.

[0015] The diameters of the main wheel 3 and idler wheels 5 are preferably dimensioned so big that the lifting device is easy to be moved also on an uneven ground.

[0016] In order to make the lifting device capable of raising and lowering itself between a lower plane and an upper plane at different levels, by the help of an operator, the lifting device comprises a pair of auxiliary supporting mechanisms 6 with height-adjustable auxiliary support wheels 9 and their support structures. The auxiliary support wheels 9 are arranged to support the lifting device at the upper plane during raising and lowering the lifting device.

[0017] In this case the upper plane may be the surface of the platform 10 of a transport vehicle, and the lower plane may be the surface of the ground or, for example, the floor of a building.

[0018] Preferably the diameter of the auxiliary support wheels 9 is smaller than the diameter of the main wheel 3 and the diameter of the idler wheels 5. Preferably, the diameter of the main wheel 3 and idler wheels 5 is about 1,1 to 6 times larger than the diameter of the auxiliary support wheels 9, depending on the size of the of the auxiliary support wheels 9.

[0019] In addition to the auxiliary support wheel 9 each auxiliary support mechanism 6 comprises a guiding mechanism 6a which is mounted to guide the motion of the auxiliary support wheel 9 in an inclined direction in relation to the vertical plane. The guiding mechanism 6a may be, for instance, a sleeve, such as a square tube which is mounted parallel to the support arms 4 but in an inclined position in relation to the support arms 4 so that the rear end of the tube is higher than the front end of the tube when the lifting device is in its operating position.

[0020] The auxiliary supporting mechanism 6 also comprises a first actuator to move the auxiliary support wheels 9 back and forth in the guiding mechanism 6a, and preferably also a second actuator, such as an electric motor, to rotate the auxiliary support wheels 9 to move the lifting device on the upper plane when the lifting device has been raised from the lower plane to the upper plane or are lowered from the upper plane to the lower plane. Moving the auxiliary support wheels 9 back and forth changes at the same time the height position of the auxiliary support wheels 9.

[0021] Each auxiliary supporting mechanism 6 is placed near the end of the horizontal frame 1a at a downward angle through the horizontal frame 1a so that the lower end of the auxiliary supporting mechanism 6 is directed forward and the upper end is directed backward.

[0022] The motion path of changing the height position of the auxiliary support wheels 9 is arranged diagonally down from the front wall of the horizontal frame 1a to extend onto the surface of the platform 10 on the upper plane from between the horizontal frame 1a and a pallet or load on the lifting forks 8. Preferably the diagonal motion path of the auxiliary support wheels 9 is linear. When the auxiliary wheels 9 are moved forward in their guiding mechanisms 6a, their height position decreases, i.e. they approach the plane on which the lifting device is currently located, and when they are moved backward,

their height position increases, whereby they detach from the plane and move away from it.

[0023] The structure of the auxiliary support wheels 9 also comprises at least one securing mechanism 9a which protects the auxiliary support wheels 9 so that nothing can prevent the auxiliary support wheels 9 from rotating.

[0024] Figs. 3 to 11 present in a side view the phases or steps of raising the lifting device according to Fig. 1 from the ground onto the platform 10 of a transport vehicle, or more generally from a lower plane to an upper plane. For the sake of clarity, no pallet or load is shown on top of the lifting forks 8.

[0025] Fig. 3 presents the phase where the lifting device has been driven with the help of the main wheel 3 close to the platform 10 of the transport vehicle. The lifting forks 8 are above the platform 10 and the upright frame 1 is as close to the rear edge of the platform 10 as possible. The raising procedure of the lifting device can be started.

[0026] Fig. 4 presents the phase where the lifting forks 8 have been pressed against the platform 10, which acts as the upper plane, and the lifting motion is reversed so that the lifting device is raised from the ground, which acts as the lower plane, with its own lifting machinery. During the raising phase the support arms 4 are pulled backwards to their rearmost position. Pulling can be done with the help of retaining members 11, which retaining members 11 are also arranged to prevent the support arms 4 from being pushed too far forward. After the support arms 4 are pulled backwards to their rearmost position, the lower parts of the lifting device can be raised so up that the main wheel 3 and the support wheels 5 are completely above the level of the surface of the platform 10.

[0027] Fig. 5 presents the situation where the support arms 4 have been pulled backwards to their rearmost position, and the support wheels 5 have been raised completely above the level of the surface of the platform 10. The lifting device rests now on the platform 10 supported by the lifting forks 8. Preferably the lifting forks 8 are made so heavy that they can keep the lifting device in this position also when there is no load on the lifting forks 8. This kind of structure also makes it possible to lower the lifting device without a load from the platform 10 to the ground or, more generally from the upper plane to the lower plane.

[0028] Fig. 6 presents the phase where the support arms 4 have been moved back forward to their actual operating position. In this phase the support wheels 5 may yet be in the air slightly above the surface of the platform 10.

[0029] Fig. 7 presents the phase where auxiliary support wheels 9 are pushed forward to their lower positions. Thanks to the inclined forward motion path the auxiliary support wheels 9 extend over the top of platform 10. For the sake of clarity, the support arm 4, which is closer to the viewer, has been removed from Fig.7.

[0030] Fig. 8 presents the phase where lifting forks are raised somewhat upwards. In this case, the support wheels 5 and auxiliary support wheels 9 fall down onto the platform 10. The rear part of the lifting vehicle is now supported by the auxiliary support wheels 9 close to the rear edge of the platform 10. For the sake of clarity, the support arm 4, which is closer to the viewer, has been removed from Fig.8.

[0031] When the auxiliary support wheels 9 are in contact with the surface of platform 10 the lifting device is driven completely onto the platform 10 by the help of the second actuator which rotates the auxiliary support wheels 9. In case the lifting device does not comprise second actuators the lifting device may be pushed manually deeper onto the platform 10.

[0032] Fig. 9 presents the phase where lifting device has been driven onto the platform 10 so that the main wheel is in contact with the with the surface of platform 10. After that the auxiliary support wheels 9 must be lifted away from the surface of the platform 10. For this operation, the pressure against the auxiliary support wheels 9 must be reduced or removed so that they can be pulled off the platform 10 to their resting position.

[0033] Fig. 10 presents the phase where the pressure has been removed by lowering the lifting fork 8 against the surface of the platform 10 and lifting the entire lifting device with its own lifting mechanism slightly upwards. Now all the wheels 3, 5 and 9 are in the air and the auxiliary support wheels 9 can easily be pulled diagonally upwards to their resting position.

[0034] Fig. 11 presents the phase where the main wheel 3 and support wheels 5 are lowered back onto surface of the platform 10 by raising the lifting fork 8 upwards. After this, the load is moved with the lifting device to the designated place on the platform 10 of the transport vehicle by driving the lifting device with the help of the main wheel 3 and its driving mechanism.

[0035] The lifting device according to the invention is moved from an upper plane to a lower plane, for example from the platform 10 of a transport device to the ground surface of the earth, by performing the above-mentioned steps in reverse order. In order to prevent the lifting device from falling off the platform 10 when the support arms 4 are in their rear position, as shown in Fig.5, the blades of the lifting forks 8 are made so heavy that they keep the lifting device balanced on the upper plane in the situation shown in Figure 5.

[0036] The lifting device also comprise a safety mechanism 12 shown in Fig.12. The safety mechanism 12 may be, for instance, a limit switch equipped with a small wheel to stop the backward motion of the lifting device when the auxiliary support wheels 9 are close to the edge of the platform 10.

[0037] The safety mechanism 12 may be placed in connection with the auxiliary support mechanism 6, preferably close to the auxiliary support wheel 9. In case the wheel of the safety mechanism rolls over the edge of the platform 10 and falls from the upper plane, the safety mechanism is arranged to immediately stop the movement of the lifting device. The lifting device may comprise

one or more safety mechanisms 12, which may be either similar or different from each other.

[0038] It is obvious to the person skilled in the art that the invention is not restricted to the examples described above but that it may be varied within the scope of the claims presented below. Thus, for example, the structures and components of the lifting device may be different from what is presented.

Claims

1. A lifting device comprising a lifting mechanism, which lifting device is arranged to be moved by means of its own lifting mechanism from a lower plane to an upper plane and vice versa, which lifting device further comprises a frame (1, 1a), a main wheel (3) connected to the frame, a pair of support arms (4) arranged to be moved relative to the frame, each of which support arm (4) comprising a support wheel (5) at its free end, and a lifting carriage (7) equipped with a pair of lifting forks (8), **characterized in that** the lifting device comprises a pair of auxiliary supporting mechanisms (6) with height-adjustable auxiliary supporting wheels (9) to support the lifting device on the upper plane.

2. A lifting device according to claim 1, **characterized in that** the lifting device comprises at least one first actuator to change the height position of the auxiliary support wheels (9).

3. A lifting device according to claim 1 or 2, **characterized in that** each auxiliary supporting mechanism (6) comprises its own first actuator to change the height position of the auxiliary support wheels (9).

4. A lifting device according to claim 1, 2 or 3, **characterized in that** the motion path of changing the height position of the auxiliary support wheels (9) is diagonal.

5. A lifting device according to claim 4, **characterized in that** the motion path of changing the height position of the auxiliary support wheels (9) is linear.

6. A lifting device according to any of claims 1-5 above, **characterized in that** the auxiliary support mechanism (6) comprises a guiding mechanism (6a) which is mounted to guide the motion of the auxiliary support wheel (9) in an inclined direction in relation to the vertical plane.

7. A lifting device according to claim 6, **characterized in that** the guiding mechanism (6a) is mounted parallel to the support arms (4) in an inclined position in relation to the support arms (4) so that the rear end of the guiding mechanism (6a) is higher than the front end of the guiding mechanism (6a) when the lifting device is in its operating position.

8. A lifting device according to any of claims 1-7 above, **characterized in that** the diameter of the auxiliary support wheels (9) is smaller than the diameter of the main wheel (3) and the diameter of the idler wheels (5).

9. A lifting device according to any of claims 1-8 above, **characterized in that** the lifting device comprises one or more safety mechanisms (12) to stop the backward motion of the lifting device when the auxiliary support wheels (9) are close to the edge of the upper plane, such as a platform (10) of a transport vehicle.

10. A method of using a lifting device, which lifting device comprises a frame (1, 1a), a main wheel (3) connected to the frame, a pair of support arms (4) arranged to be moved relative to the frame, each of which support arm (4) comprising a support wheel (5) at its free end, and a lifting mechanism with a lifting carriage (7) equipped with a pair of lifting forks (8), which lifting device is moved by means of its own lifting mechanism from a lower plane to an upper plane and vice versa, **characterized in that** when moving the lifting device between the two planes at different heights, the auxiliary support wheels (9) are lowered against the upper plane for supporting the movement of the lifting device on the upper plane.

11. A method for using the lifting device according to claim 10, **characterized in that** the auxiliary support wheels (9) are lowered to their lower position above the upper plane when the support arms (4) are in their front position above the upper plane.

12. A method for using the lifting device according to claim 10 or 11, **characterized in that** the auxiliary support wheels (9) are lowered to their lower position between the main wheel (3) and the idler wheels (5).

13. A method for using the lifting device according to claim 10, 11 or 12, **characterized in that** when moving the lifting device, supported by the main wheel (3) and support wheels (5), the auxiliary support wheels (9) are kept off the surface on which the lifting device is moved.

14. A method for using the lifting device according to any of the claim 10-13 above, **characterized in that** a safety mechanism (12) is used to stop the backward motion of the lifting device when the auxiliary support wheels (9) are close to the edge of upper plane, such as the platform (10) of the transport vehicle.

15. A method for using the lifting device according any of

the claim 10-14 above, **characterized in that** the method comprises one or more of the following steps:

- the lifting device is moved close to the upper plane so that the lifting forks (8) are above the upper plane and the support arms (4) are under the upper plane,
- the lifting forks (8) are supported on the upper plane after which the lifting device is started to raise by the help of its own lifting machinery towards to upper plane, and during raising the support arms (4) are moved to their rear position,
- after the main wheel (3) and idler wheels (5) are above the level of the upper plane the support arms (4) are moved to their front position,
- the auxiliary support wheels (9) are lowered to their lower position above the upper plane,
- the lifting forks (8) are lifted upwards to lower the idler wheels (5) and the auxiliary support wheels (9) onto the upper plane,
- the main wheel (3) is moved onto the upper plane,
- the lifting forks (8) are supported on the upper plane after which the auxiliary support wheels (9) are lifted away from the upper plane,
- the lifting forks (8) are lifted upwards to lower the idler wheels (5) and the main wheel (3) onto the upper plane,
- the lifting device is moved on the upper plane to a wanted place.

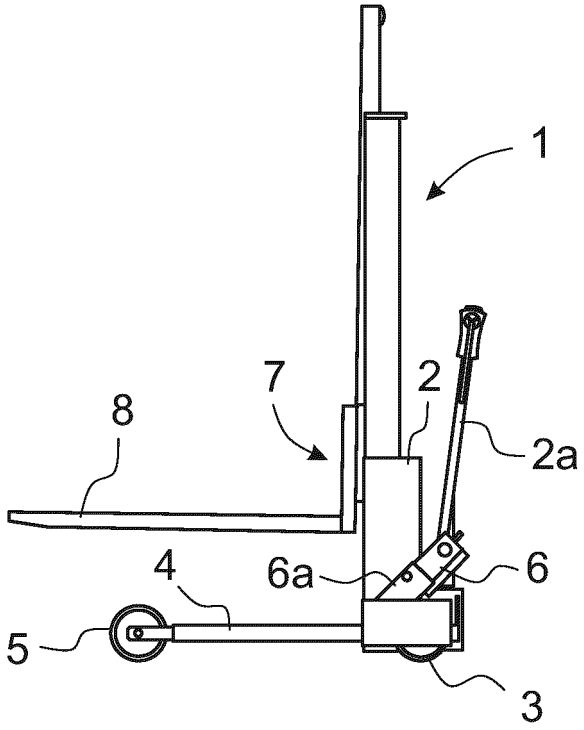

Fig. 1

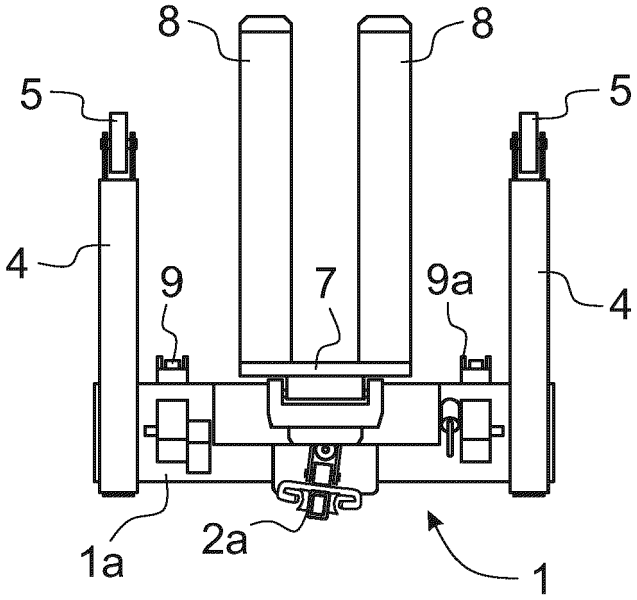

Fig. 2

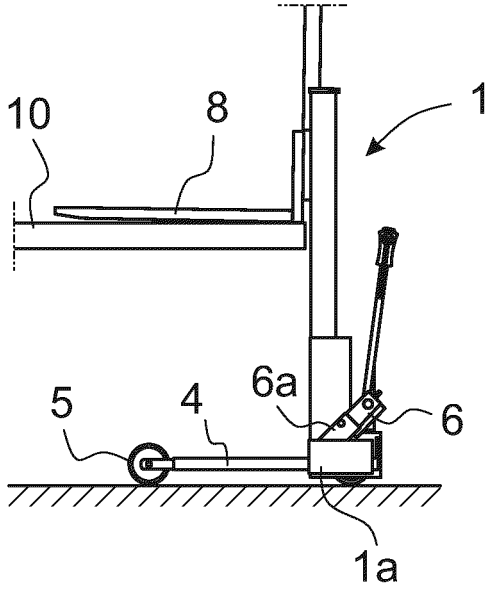

Fig. 3

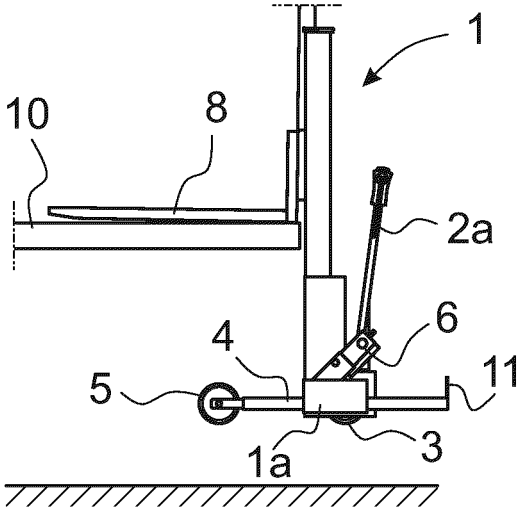

Fig. 4

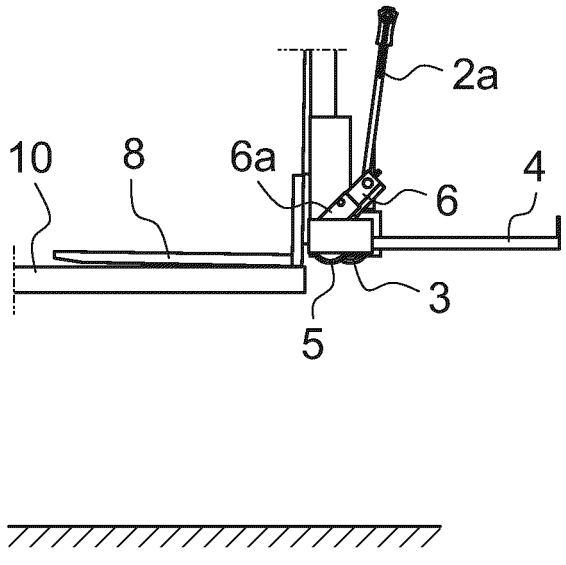

Fig. 5

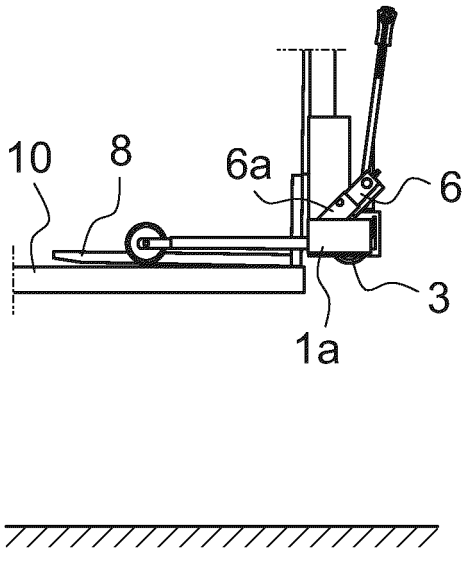

Fig. 6

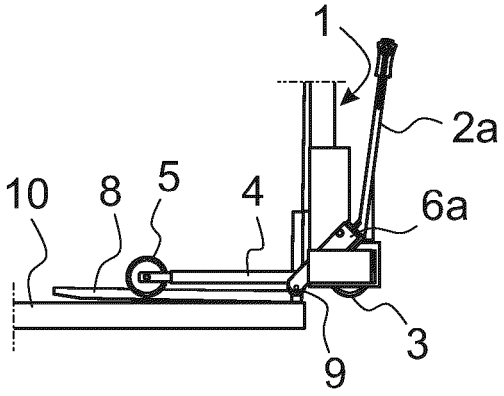

Fig. 7

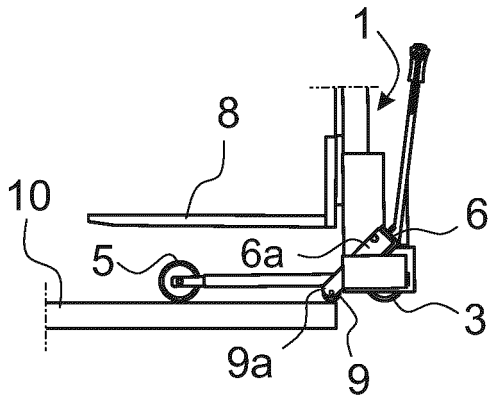

Fig. 8

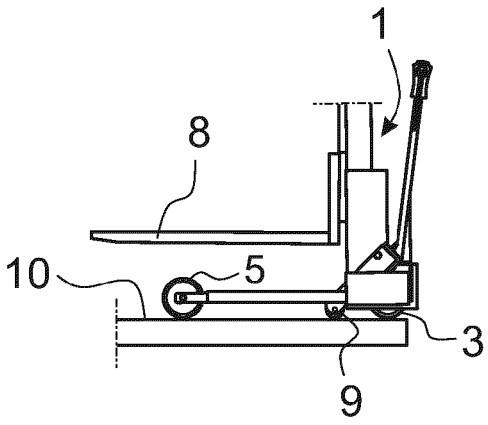

Fig. 9

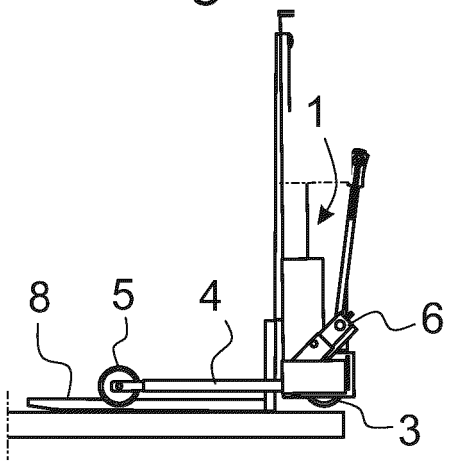

Fig. 10

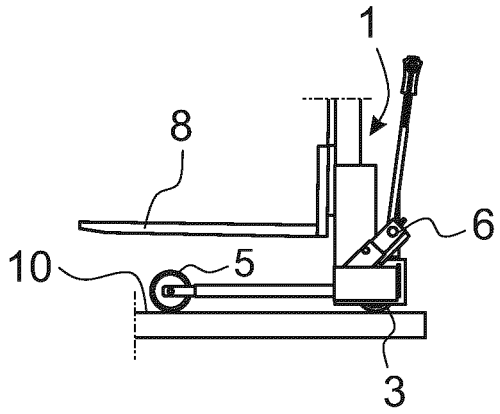

Fig. 11

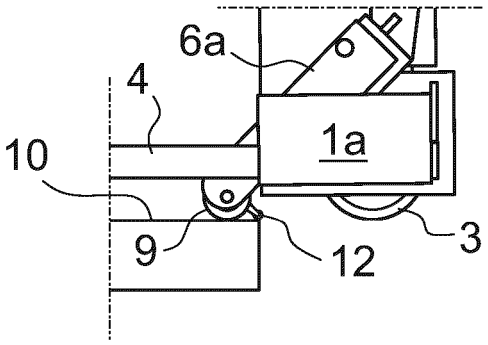

Fig. 12

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EUROPEAN SEARCH REPORT

Application Number
EP 23 21 6574

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	DE 20 2013 105333 U1 (EDAG PRODUCTION SOLUTIONS GMBH & CO KG [DE]) 15 January 2014 (2014-01-15)	1-3,10, 13,15	INV. B66F9/075
Y	* paragraphs [0042] - [0052]; claim 11; figures 16-33 *	9,11,12, 14	
X,D	US 4 061 237 A (AUSTIN STEPHEN R ET AL) 6 December 1977 (1977-12-06)	1,4-8	
Y	* figures 1, 4, 5 *	12	
Y	DE 10 2012 111582 A1 (HUELSKOPF ANDREAS [DE]) 14 August 2013 (2013-08-14) * paragraphs [0048], [0052] *	9,14	
Y	DE 696 05 284 T2 (CARTON DE TOURNAI FRANCOIS XAV [BE]) 3 August 2000 (2000-08-03) * figure 13D *	11	
			TECHNICAL FIELDS SEARCHED (IPC)
			B66F

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	17 May 2024	Güzel, Ahmet

CATEGORY OF CITED DOCUMENTS

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