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(54) **A forklift truck, a method and a computer program for controlling a forklift truck**

(57) The present invention relates to a forklift truck (10) comprising a truck body (20) and forks (40) which are horizontally movable in relation to the truck body (20) between a home position and a fully extended position. The forklift truck (10) comprises a control unit (22) arranged to control a maximum allowed horizontal accel-

eration and/or retardation of the forks (40) in relation to a maximum acceleration and/or retardation value for the forklift truck based on whether a movement of the forks is directed away from (x1; y1) the truck body (20) or towards (x2; y2) the truck body (20).

The present invention also relates to a method of controlling the forklift truck (10).

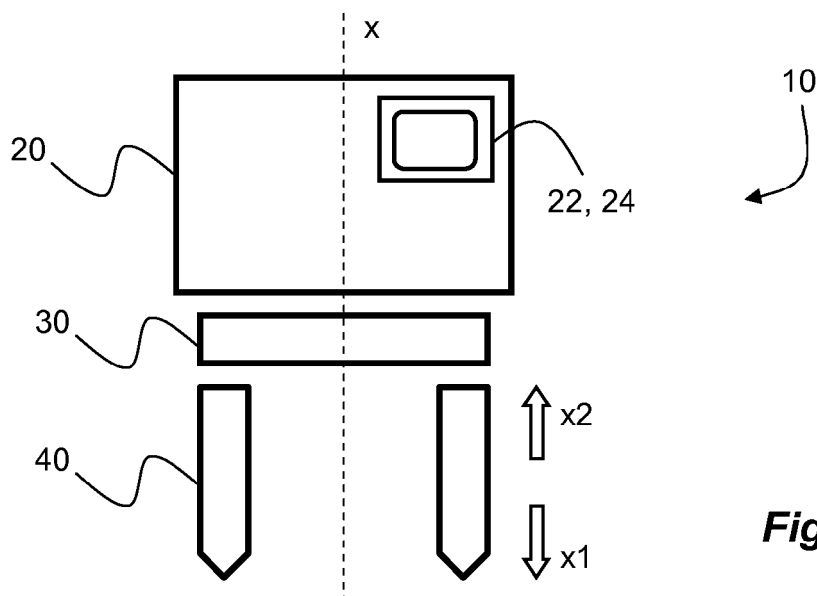


Fig 1

Description

Technical Field

[0001] The present invention assigns to forklift trucks, e.g. reach trucks or very narrow aisle forklift trucks, having forks which are horizontally movable in relation to the truck body.

Background Art

[0002] Forklift trucks shall preferably be able to handle palletised goods quickly and safely, require little service and have a long useful life. These requirements are somewhat conflicting, since rapid goods handling may lead to reduced stability and increased wear.

[0003] Document EP1203745 A1 describes an industrial lift truck having a truck body and a load supporting member that is movable in a vertical direction and in a horizontal direction in relation to the truck body. The truck is adapted to reduce the maximum allowed acceleration of the load supporting member in the horizontal direction when the load supporting member carries heavy load and is located at high vertical positions in relation to the truck body.

[0004] The objects of the present invention are to further improve the productivity and the useful life of forklift trucks by optimizing the goods handling.

Disclosure of Invention

[0005] The objects of the present invention have been solved by providing a forklift truck comprising a truck body and forks which are horizontally movable in relation to the truck body between a home position and a fully extended position. According to the invention, the forklift truck is configured so that the maximum allowed acceleration and/or retardation of the forks in relation to the truck body in a horizontal direction is dependent on whether said acceleration and/or retardation is directed away from or towards the truck body and based on a current position of the forks. The forklift truck comprises a control unit arranged to control the maximum allowed horizontal acceleration and/or retardation of the forks in relation to a maximum acceleration and/or retardation value for the forklift truck based on whether the movement of the forks is directed away from the truck body or towards the truck body and based on the current position of the forks in relation to the home position and/or the fully extended position.

[0006] In this way, the invention makes possible an optimisation of the movement of the forks in the horizontal direction. By optimising the acceleration by making it dependent on whether the forks are to be accelerated away from or towards the truck body and dependent on the current position of the forks, the invention enables a higher fork acceleration/retardation under certain conditions, which improves the productivity. At the same time, the

movement can be optimised so as to reduce the fork acceleration/retardation in certain cases, which improves the useful life of forklift trucks. For example, the maximum allowed acceleration of the forks in a translational movement may be reduced, or even set to zero, during a simultaneous horizontal rotational acceleration.

[0007] In one example, the control unit is arranged to control the maximum allowed horizontal acceleration and/or retardation based on the horizontal movement of a centre of gravity of the forks, with any load, in relation to a centre of gravity of the truck body.

[0008] In one option, the maximum allowable acceleration increases with the increasing distance to the home position when the movement of the forks is directed away from the truck body. The increasing of the maximum allowable acceleration with the increasing distance to the home position when the movement of the forks is directed away from the truck body is performed at least in a sub-range of a range between the home position and/or the fully extended position.

[0009] In one option, the maximum allowable retardation decreases with the increased distance to the home position when the movement of the forks is directed away from the truck body. The decreasing of the maximum allowable retardation with the increased distance to the home position when the movement of the forks is directed away from the truck body is performed at least in a sub-range of a range between the home position and/or the fully extended position.

[0010] In one option, the maximum allowable acceleration is increased with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body. The increasing of the maximum allowable acceleration with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body is performed at least in a sub-range of a range between the home position and/or the fully extended position.

[0011] In one option, the maximum allowable retardation is decreased with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body. The decreasing of the maximum allowable retardation with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body is performed at least in a sub-range of a range between the home position and/or the fully extended position.

[0012] The forklift truck may be a reach truck, which apart from vertical linear movement of the forks allows horizontal translational movement of the forks only. Said horizontal translational movement of the forks can also be referred to as the forks being moved in parallel with the longitudinal direction of the reach truck.

[0013] The forks are in one option also horizontally movable so as to perform a rotational movement around a rotation axis of the forks. In a specific example, where the forklift truck is a very narrow aisle forklift truck, the forks are rotatably arranged in a support point. The sup-

port point is operatively connected to the truck body such that it is translationally movable in relation to the truck body at least in a direction perpendicular to a forward direction of the truck. When both a translative and rotational movement is possible, the direction of the movement of the forks in relation to the truck body is determined based on the contribution from the translational movement and on the contribution from the rotational movement. In one example, the translational acceleration is optimized while the characteristics of the rotational movement are pre-set. In another example, the translational acceleration and the rotational accelerations are both optimized.

[0014] In one option, the maximum allowed acceleration of the forks in a horizontal translational direction is higher if the forks simultaneously has a horizontal rotational acceleration with an acceleration component in a direction opposite the horizontal translational direction than if no rotational acceleration occurs. The same applies for retardation.

[0015] In one option, the maximum allowed acceleration of the forks (40) in a horizontal translational direction is lower if the forks simultaneously has a horizontal rotational acceleration with an acceleration component in a direction coinciding with the horizontal translational direction than if no rotational acceleration occurs. The same applies for retardation.

[0016] For example, the maximum allowed acceleration of the forks in a horizontal translational direction along an axis perpendicular to the forward direction of the truck away (y_1) from the truck body may be higher if the forks are to be simultaneously horizontally rotationally accelerated around its rotational axis (z_1) in a direction such that the rotational movement has an acceleration component in a direction opposite the translational movement. Likewise, the maximum allowed acceleration of the forks in the translational movement may be lower if the forks are to be simultaneously horizontally rotationally accelerated around its rotational axis (z_2) in a direction such that the movement has an acceleration component in the direction coinciding with the translational movement. The maximum allowed acceleration of the forks (40) in a horizontal translational direction along the axis perpendicular to the forward direction of the truck towards (y_2) the truck body (20) may be higher if the forks (40) are to be simultaneously horizontally rotationally accelerated around its rotational axis (z_2) in a direction such that the rotational movement has an acceleration component in a direction opposite the direction of the translational movement. Likewise, the maximum allowed acceleration of the forks in the translational movement is lower if the forks are to be simultaneously horizontally rotationally accelerated around its rotational axis (z_1) in a direction such that the movement has an acceleration component in the direction coinciding with the translational movement. The above applies also to retardation, not only acceleration.

[0017] In one option, the control unit is arranged to determine the maximum allowed acceleration and/or retardation based on an angular relation between the forks

and a forward direction of the forklift truck. For example, when the forks are in their home rotational position a higher translational acceleration/retardation can be allowed than when the forks are not in their home rotational position.

[0018] In one option, the control unit is arranged to determine the maximum allowed acceleration and/or retardation based on the distance between the forks and the truck body (20) at the starting point and/or stop point of the movement of the forks.

[0019] In one option control, the control unit is arranged to determine the maximum acceleration and/or retardation value for the forklift truck based on the weight of a load carried by the forks. For instance, when carrying a light-weight load, or no load at all, the forklift truck may allow very high acceleration. A heavy load may lead to a reduction of the acceleration. A heavy load combined with a simultaneous horizontal rotational acceleration of the forks may result in the forklift truck not allowing any acceleration of the forks in a horizontal linear direction, or only allowing horizontal linear acceleration in one direction. Alternatively, or in addition thereto, the control unit may be arranged to determine the maximum acceleration and/or retardation value for the forklift truck based on the height of the forks. The height of the forks may in one example be determined as the height of the center of gravity of the forks with load, if any.

[0020] As regards the optimisation of the movement of the forks, not only the acceleration but also the speed may be affected. By adjusting also the maximum allowed speed, said advantages regarding the productivity and useful life are augmented.

[0021] Also, the objects of the present invention have been solved by providing a method of controlling a forklift truck comprising a truck body and forks which are movable in relation to the truck body in a horizontal direction. According to the invention, the method comprises the steps of

- registering a command for acceleration/retardation of the forks in relation to the truck body,
- performing an acceleration analysis in order to determine whether said command involves horizontal acceleration/retardation the forks away from the truck body or towards the truck body, and
- adjusting the maximum allowed acceleration/retardation of the forks based on the acceleration analysis and based on the current position of the forks.

[0022] The method is applicable on forklift trucks capable of moving the forks linearly in parallel with the longitudinal direction of the forklift truck, and on forklift trucks capable of moving the forks linearly in the traverse direction. The method is also applicable on forklift trucks capable of moving the forks linearly in the traverse direction of the forklift truck and in addition moving the forks rotationally in a horizontal plane. In the latter case, both said

linear acceleration analysis and said rotary acceleration analysis may be performed in order to achieve enhanced optimisation.

[0023] Said method may include adjusting also the maximum allowed speed of the forks in the adjustment step. Also, a load weight and/or height analysis step may be performed, and the adjustment may be based also on the load weight and/or height analysis.

[0024] Finally, the objects of the present invention have been solved by providing a computer program which, when executed by an on-board computer of a forklift truck, causes said forklift truck to perform the above mentioned method. According to one aspect of the invention, the computer program is stored on a non-transitory computer-readable medium.

Brief Description of Drawings

[0025] Exemplary embodiments of the present invention are described below with reference to the enclosed drawings, in which

- figure 1 schematically illustrates a reach truck from above,
- figure 2 is a schematic perspective view of a reach truck similar to the one of figure 1,
- figure 3 schematically illustrates a very narrow aisle forklift truck from above,
- figure 4 is a perspective view of a very narrow aisle forklift truck similar to the one of figure 3,
- figure 5 shows two very narrow aisle forklift trucks as the one of figure 4 from above, with the forks in different extreme traverse positions, and
- figure 6 illustrates a method of controlling a forklift truck.
- Figure 7 illustrates a diagram of acceleration/retardation schemes for a fork movement

Modes for Carrying Out the Invention

[0026] Figure 1 illustrates a reach truck 10 from above. The reach truck 10 comprises a truck body 20, a fork support structure 30 carried by the truck body 20, and two lift forks 40 attached to the fork support structure 30. The reach truck 10 is controlled by a control unit 22. The control unit 22 comprises an on-board computer. As is illustrated by arrows in figure 1, the forks 40 can be moved away from x1 and towards x2 the truck body 20 in the longitudinal or forward direction x of the reach truck 10. By the longitudinal or forward direction x of the present reach truck 10 is meant the direction in which the forks 40 extend.

[0027] Figure 2 shows the reach truck 10 of figure 1 in more detail. A lift mast 35 which carries the fork support structure 30 is disclosed. The lift mast 35 is carried by the truck body 20 and is capable of lifting the fork support structure 30 and thus the forks 40 in a vertical direction. When the reach truck 10 performs a reach movement,

i.e. moves the forks 40 horizontally away from x1 or towards x2 the truck body 20 in a translational movement, the entire lift mast 35 is moved horizontally away from or towards the truck body 20. Figure 2 also discloses wheels that support the truck body 20, and an operator's compartment on the truck body 20.

[0028] Figures 1 and 2 illustrate the reach truck 10 with the forks 40 in the innermost reach position, i.e. the position in which the forks 40 are closest to the truck body 20. This position is also referred to as the home position.

[0029] The control unit 22 of the reach truck 10 is capable of controlling the fork 40 movement in an optimised manner. The control unit 22 is arranged to control the fork acceleration and/or retardation characteristics in relation to a maximum acceleration/retardation value based on the direction of the fork movement and based on the current position of the forks. Thus, a maximum acceleration/retardation value for the truck is determined and the maximum acceleration/retardation value is adjusted so as to form a maximum allowable acceleration and/or retardation at each position along a range from a starting position to an end position of a fork movement. The forming of the maximum allowable acceleration and/or retardation in each position is based on the current position of the forks in relation to the home position and the fully extended position and based on the direction of the movement of the forks. Thus, the acceleration/retardation process in moving the forks can be optimized to improve the productivity and/or improves the useful life of forklift trucks.

[0030] Forces are acting on the forklift truck, the forks and the load as the forks are performing an acceleration/retardation movement. In detail, when the forks and load are performing a reach movement and accelerating and/or retardation is performed, forces arise corresponding to $F=m \cdot a$. Further, the force of gravity and the acceleration/retardation forces give rise to normal forces acting on the wheels of the forklift truck. Further, the acceleration/retardation forces give rise to a horizontal reaction force on a breaking wheel(s). The above described forces together affect the stability of the forklift truck. Thus, the movement direction of the forks, the position of the forks and the acceleration/retardation of the forks together affect the stability of the forklift truck. This relationship can be used in order to adapt the maximum allowed acceleration and/or retardation to the current situation. Thus, the maximum allowable acceleration/retardation can be determined and applied for each fork position and fork movement direction to allow as high acceleration/retardation as possible at each point along the movement while at the same time fulfilling preset stability criteria for the forklift truck.

[0031] The forklift truck is often built to be statically most stable in the home position.

[0032] In one example, the maximum allowable acceleration is increasing with the increased distance to the home position when the movement of the forks is directed away from the truck body. In one example, the maximum

allowable retardation is decreasing with the increased distance to the home position when the movement of the forks is directed away from the truck body. In one example, the maximum allowable acceleration is increased with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body. In one example, the maximum allowable retardation is decreased with the increased distance to the fully extended position when the movement of the forks is directed towards the truck body.

[0033] In the acceleration/retardation diagram illustrated in Fig 7, the curves for maximum allowed acceleration and retardation substantially coincide for opposing movement directions. In detail, the maximum allowed acceleration when the movement of the forks is directed away from the truck body at each position between the home position and the fully extended position substantially equals the maximum allowed retardation when the movement of the forks is directed towards the truck body. The above maximum allowable accelerating movement directed away from the truck body and retarding movement directed towards the truck body are increased with the distance to the home position. Correspondingly, the maximum allowed acceleration when the movement of the forks is directed towards the truck body at each position between the fully extended position and the home position equals the maximum allowed retardation when the movement of the forks is directed from the truck body. The maximum allowable accelerating movement directed towards the truck body and the retarding movement directed from the truck body are then decreased with the distance to the home position. The diagram of fig 7 shows principles and not the actual values for the maximum allowed accelerations/retardations.

[0034] Further, in the illustrated example of Fig 7, the control unit 22 is arranged to allow a higher acceleration of the reach movement in the direction from x1 the truck body 20 than in the direction towards x2 the truck body 20. In one complementing or alternative example, the control unit 22 is arranged to allow a higher retardation of the reach movement in the direction towards x2 the truck body 20 than in the direction away from x1 the truck body 20. A reach movement towards the truck body 20 typically corresponds to the reach truck 10 retrieving a pallet from a pallet shelf in a warehouse. The acceleration of the movement is characteristically performed from a starting position for the movement. The retardation of the movement is characteristically performed when closing an end position for the movement.

[0035] In one example, the control unit is arranged to set the maximum allowed acceleration 10-35% preferable 20-25% higher if said acceleration is directed away from the home position than if it is directed towards the home position. In one example, the control unit is arranged to set the maximum allowed retardation 10-35% preferable 20-25% higher if said retardation is directed towards the home position than if it is directed away from the home position.

[0036] The horizontal movement of the forks may be defined as the horizontal movement of a centre of gravity of the forks, with any load. The horizontal movement of the forks in relation to the truck body may be defined as the horizontal movement of the forks in relation to a centre of gravity of the truck body (20).

[0037] In one example, the control unit 22 is further arranged to adjust the maximum allowed acceleration/retardation value based on the weight of a load carried by the forks (40) and/or the lift height or height of centre of gravity of the forks with load, if any.

[0038] The control unit 22 is in one example arranged to determine the maximum allowed speed of the forks (40) in relation to the truck body (20). The maximum allowed speed of the forks is based on one or more of the following

- The direction of the movement. The maximum allowable speed directed towards the home position may be higher than the maximum allowable speed directed away from the home position.
- The weight of the load, if any
- The lift height or height of centre of gravity of the forks with load, if any.

[0039] Figure 3 illustrates a very narrow aisle forklift truck 15, often abbreviated VNA, from above. The VNA 15 comprises a truck body 20, a fork support structure 30, two lift forks 40 and a control unit 22. The control unit 22 comprises an on-board computer. As is illustrated by straight arrows in figure 3, the fork support structure 30 with the forks 40 can be moved horizontally in a direction y perpendicular to a longitudinal or forward direction of the truck. In a home position the fork support structure is positioned in relation to the truck body such that the forks are essentially not extending outside the side walls of the truck body. One example of the home position for the VNA is illustrated in the Figure 3. In the illustrated figure, the support structure is in the home position substantially aligned with one of the side walls. The forks are further in the home position extending along the front of the VMA in a direction y perpendicular to the longitudinal or forward direction of the VNA.

[0040] The fork support structure 30 with the forks is arranged to perform a translational movement away from y1 and towards y2 the home position. As the home position is aligned with the truck body 20, the translational movement of the fork support structure 30 is also performed away from y1 and towards y2 the home position. As is illustrated by curved arrows in figure 3, the fork support structure 30 with the forks 40 is also horizontally routable around a vertical axis z. In the illustrated example, the vertical axis z is provided in the support structure. However, there are numerous other ways of connecting the fork support structure 30 with the associated forks 40 to a rotational support structure. The rotational movement around the vertical axis z causes the forks rotate away from z1 and towards z2 the home position. Accord-

ingly, the rotational movement around the vertical axis z causes the forks rotate away from $z1$ and towards $z2$ the truck body. By the longitudinal direction of the present VNA 15 is meant the direction which is perpendicular to the extension of the forks 40, when the forks 40 are located in their innermost rotational position, i.e. the position as shown in figures 4 and 5.

[0041] Figures 4 and 5 show the VNA 15 in detail. A lift mast 35 is capable of lifting the fork support structure 30 and thus the forks 40 in a vertical direction z . When the VNA 15 performs a reach movement, i.e. moves the forks 40 horizontally linearly away from $y1$ or towards $y2$ the truck body 20, the fork support structure 30 and thus the forks 40 are moved in relation to the lift mast 35 and thus in relation to the truck body 20. The direction y which is perpendicular to the longitudinal direction of the VNA 15 is also referred to as the traverse direction.

[0042] Figure 5 illustrates the VNA 15 with the forks 40, and the fork support structure 30, in two extreme reach positions. To the left in figure 5 the forks 40 are in the reach position which is closest to the truck body, and to the right the forks 40 are in the reach position which is furthest away from the truck body 20.

[0043] When the VNA 15 performs combined linear (in y -direction) and rotational (around z -direction) movements of the forks 40, these combined movements give rise to interacting inertial forces. This interaction can be utilised to optimise the fork 40 movement. The direction of the movement of the forks in relation to the truck body is in one example determined based on the contribution from the translational movement and on the contribution from the rotational movement.

[0044] The control unit 22 of the VNA 15 is capable of controlling the fork 40 movement in an optimised manner. The control unit 22 is arranged to control the fork acceleration and or retardation characteristics based on the direction of the composite fork movement and the position and optionally also the angular position of the forks. The control unit is arranged to operate in the same manner as the control unit of the reach truck as described above with some adaptations disclosed below due to the capability of composite movement of the forks.

[0045] It has been realized that the acceleration of the reach movement in the direction away from $y1$ the truck body 20 can be increased provided that the forks 40 are simultaneously rotationally accelerated in the direction away from $z1$ the truck body 20. With reference to figures 3 and 4, a higher acceleration of the forks 40 to the left $y1$ in figure 3 is allowed if the forks 40 are also accelerated clockwise $z1$. Analogously, a higher acceleration of the forks 40 to the right $y2$ in figure 3 is allowed if the forks 40 are also accelerated counter-clockwise $z2$.

[0046] The horizontal movement of the forks may be defined as the horizontal movement of a centre of gravity of the forks, with any load. The horizontal movement of the forks in relation to the truck body may be defined as the horizontal movement of the forks in relation to a centre of gravity of the truck body (20).

[0047] The VNA 15 moving the forks 40 transversally towards $y2$ the truck body 20 typically corresponds to the VNA 15 retrieving a pallet from a pallet shelf in a warehouse. A common manoeuvre of a VNA 15 is to combine transversal and rotational movements in order to perform a pallet-turning, which means that the forks 40, and the load carried thereby, are turned 180° . Such a pallet-turning can be completed automatically by the control unit 22 comprising the onboard computer. Now, the above described optimisation, which is based on utilising the interacting inertial forces, significantly shortens the time needed for performing a pallet-turning. Tests have shown that said time can be shortened by up to 30 %.

[0048] The VNA 15 may comprise detectors (not shown) that are capable sensing the rotational fork position. Said detectors may also allow measurement of the rotational fork acceleration. Alternatively, the position and/or acceleration may be calculated by the on-board computer 22, based on control signals sent by the on-board computer 22 for moving the forks 40. The reach truck 10 and the VNA 15 also comprise control panels (indicated in figures 2 and 4) by means of which an operator may command fork movements. The detectors and the control panels are connected to the on-board computer 22. The on-board computer 22 is capable of controlling the movement of the forks 40 in relation to the truck body 20.

[0049] In one example, the control unit is arranged to determine the maximum allowed acceleration and/or retardation based on the angular relationship between the forks and the longitudinal or forward direction of the forklift truck.

[0050] The control unit 22 is in one example further arranged to determine the maximum allowed speed of the forks (40) in relation to the truck body (20). The maximum allowed speed of the forks is based on one or more of the following

- The direction of the reach movement in relation to the forklift truck
- The weight of the load, if any
- The lift height or height of centre of gravity of the forks with load, if any,
- The rotational position of the forks and/or the direction of the forks in relation to the longitudinal or forward direction of the forklift truck.

[0051] Figure 6 illustrates a method 100 of controlling a forklift truck, which method 100 will now be described with reference to the VNA 15 of figures 3-5. The method of controlling the reach truck 10 of figures 1 and 2 is similar, with the exception that the reach truck 10 is not able to rotate the forks.

[0052] The method 100 comprises a first step 110 in which a command for reach movement of the forks 40 is registered. Said command is normally executed by the operator via the control panel, but the command could also originate from a distant location if the VNA 15 is

remote controlled.

[0053] In a second step 120, a translation motion analysis 120 is performed in order to determine whether the forks 40 are to be moved away from (in direction y1) the truck body 20 or towards (in direction y2) the truck body 20. The translation motion analysis 120 comprises evaluating the command.

[0054] In a third step 130, a rotational motion analysis 130 is performed in order to determine a simultaneous rotational acceleration (around axis z) of the forks 40. "Simultaneous" means that the rotational acceleration is on-going, or will be on-going when the reach movement is performed. If the forklift truck is not arranged to perform a rotational motion, this step is omitted.

[0055] Finally, the method 100 comprises the step 140 of adjusting the maximum allowed acceleration of the forks 40 in the reach direction y based on the translation motion analysis 120 and the rotational motion analysis 130, if any.

[0056] The method 100 may also comprise a step of reducing the maximum reach movement speed. Also, a load weight and/or height analysis may be performed. For this reason, a load meter (not shown) may be arranged on the VNA 15. As been discussed above also other analysis's may be performed for example based on the position of the forks in relation to the forklift truck. The position in relation to the forklift truck may be given as either a distance or a rotational position, or both. The step 140 of adjusting the maximum allowed reach acceleration of the forks 40 may be based also the on the load weight analysis and other analysis's, if any.

[0057] All the steps described above are performed by the on-board computer 22. The method 100 is typically implemented by means of a computer program which, when executed by a processing unit of the on-board computer 22 of the forklift truck causes the forklift truck to perform the method 100. The computer program may be stored on a computer-readable medium 24 accessible by the processing unit.

[0058] Throughout this text, a "horizontal" direction refers to a direction which is parallel with the horizontal plane. Strictly speaking, a forklift truck reach movement is horizontal if the forklift truck is operated on a horizontal surface. Therefore, the wording "horizontal" could be replaced by "horizontal when the forklift truck is operated on a horizontal surface". Small derivations from the horizontal plane may occur. For instance, a reach movement which extends 1 meter in the horizontal plane could also extend a few millimetres in the vertical plane. However, it is believed appropriate to describe such a reach movement as horizontal.

[0059] Even though the embodiments described refer to a reach truck 10 and a very narrow aisle forklift truck 15, it is to be understood that the invention may be applied to any forklift truck having forks which are horizontally movable in relation to the truck body.

Claims

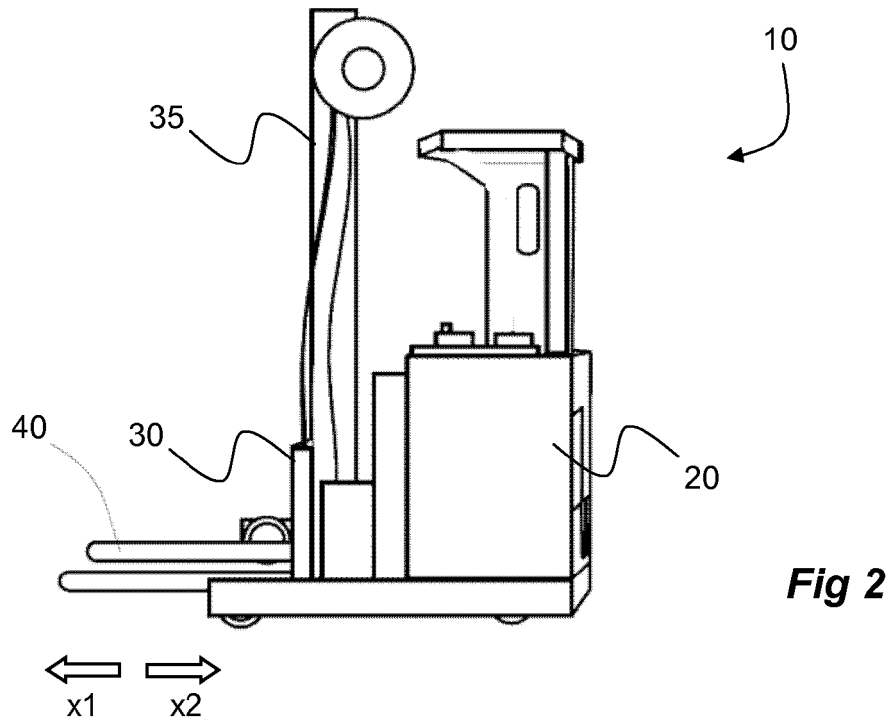
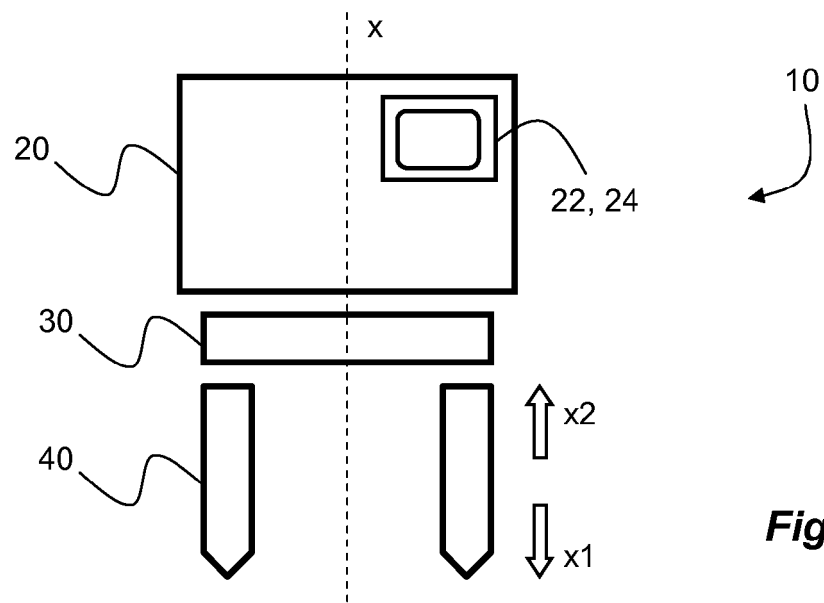
1. A forklift truck (10; 15) comprising a truck body (20) and forks (40) which are horizontally movable in relation to the truck body (20) between a home position and a fully extended position, **characterised in that** the forklift truck (10; 15) comprises a control unit (22) arranged to control a maximum allowed horizontal acceleration and/or retardation of the forks (40) in relation to a maximum acceleration and/or retardation value for the forklift truck based on whether a movement of the forks is directed away from (x1; y1) the truck body (20) or towards (x2; y2) the truck body (20) and based on the current position of the forks in relation to the home position and/or the fully extended position.
2. A forklift truck according to claim 1, wherein the maximum allowable acceleration is increasing with the distance to the home position when the movement of the forks is directed away from the truck body.
3. A forklift truck according to any of the preceding claims, wherein the maximum allowable retardation is decreasing with the distance to the home position when the movement of the forks is directed away from the truck body.
4. A forklift truck according to any of the preceding claims, wherein the maximum allowable acceleration is increased with the distance to the fully extended position when the movement of the forks is directed towards the truck body.
5. A forklift truck according to any of the preceding claims, wherein the maximum allowable retardation is decreased with the distance to the fully extended position when the movement of the forks is directed towards the truck body.
6. The forklift truck (10) of any of the preceding claims, wherein the forklift truck is a reach truck where the forks are horizontally movable so as to perform a translation movement.
7. The forklift truck of claim 6, wherein the forks are horizontally movable so as to perform a rotational movement around a rotation axis of the forks.
8. The forklift truck (15) of claim 7, said forklift truck being a very narrow aisle forklift truck (15), wherein the forks are rotatably arranged in a support point, said support point being operatively connected to the truck body such that it is translationally movable in relation to the truck body at least in a direction perpendicular to a forward direction of the truck.
9. The forklift truck of claim 7 or 8, wherein the direction

of the movement of the forks in relation to the truck body is determined based on the contribution from the translational movement and on the contribution from the rotational movement.

10. The forklift truck of any of the claims 7 - 9, wherein said maximum allowed acceleration and/or retardation of the forks (40) in a horizontal translational direction is higher if the forks (40) simultaneously has a horizontal rotational acceleration with an acceleration component in a direction opposite the horizontal translational direction than if no rotational acceleration occurs.
11. The forklift truck (15) of any of the claims 7 - 10, wherein said maximum allowed acceleration and/or retardation of the forks (40) in a horizontal translational direction is lower if the forks (40) simultaneously has a horizontal rotational acceleration with an acceleration component in a direction coinciding with the horizontal translational direction than if no rotational acceleration occurs.
12. The forklift truck of any of the preceding claims, wherein the control unit is arranged to determine the maximum allowed translational acceleration and/or retardation based on an angular relation between the forks and a forward direction of the forklift truck.
13. The forklift truck of any of the preceding claims, wherein the control unit is arranged to determine the maximum allowed acceleration and/or retardation based on the distance between the forks and the truck body (20) at the starting point and/or stop point of the movement of the forks.
14. The forklift truck (10; 15) of any of the preceding claims, wherein the maximum acceleration and/or retardation value for the forklift truck is determined based on the weight of a load carried by the forks (40) and/or the height of the forks.
15. The forklift truck (10; 15) of any preceding claim, wherein said the control unit further is arranged to determine the maximum allowed speed of the forks (40) in relation to the truck body (20).
16. A method (100) for controlling a forklift truck (10; 15) comprising a truck body (20) and forks (40) which are horizontally movable in relation to the truck body (20) in a horizontal direction between a home position and a fully extended position, **characterised by** the steps of
 - registering (110) a command for acceleration/retardation of the forks (40) in relation to the truck body (20),
 - performing an acceleration analysis (120) in

order to determine whether said command involves horizontal acceleration/retardation the forks (40) away from (x1; y1) the truck body (20) or towards (x2; y2) the truck body (20), and
- adjusting (160) the maximum allowed acceleration of the forks (40) based on the acceleration analysis and based on the current position of the forks in relation to the home position and/or the fully extended position.

17. A computer program which, when executed by an on-board computer (22) of a forklift truck (10; 15), causes said forklift truck (10; 15) to perform the method of claim 16.



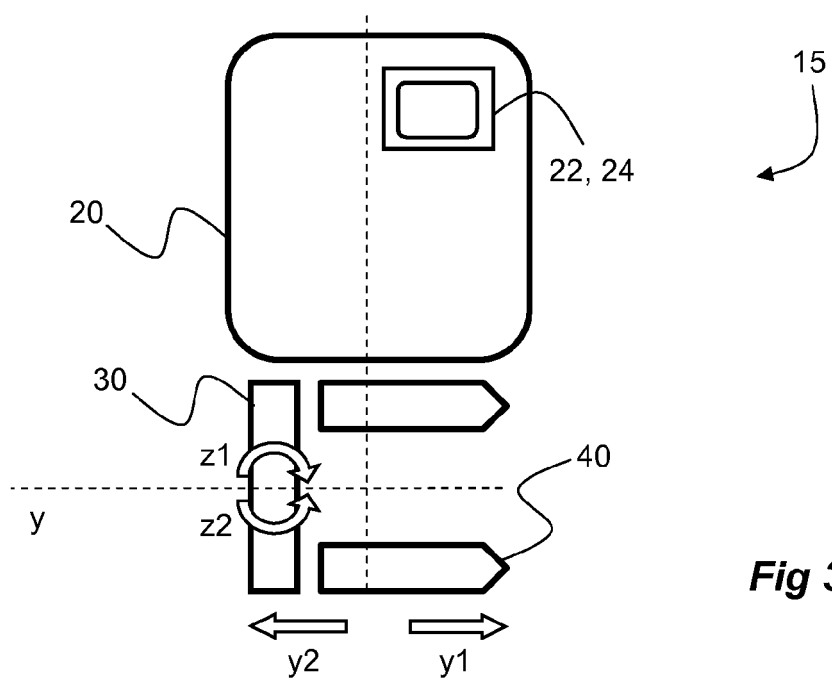


Fig 3

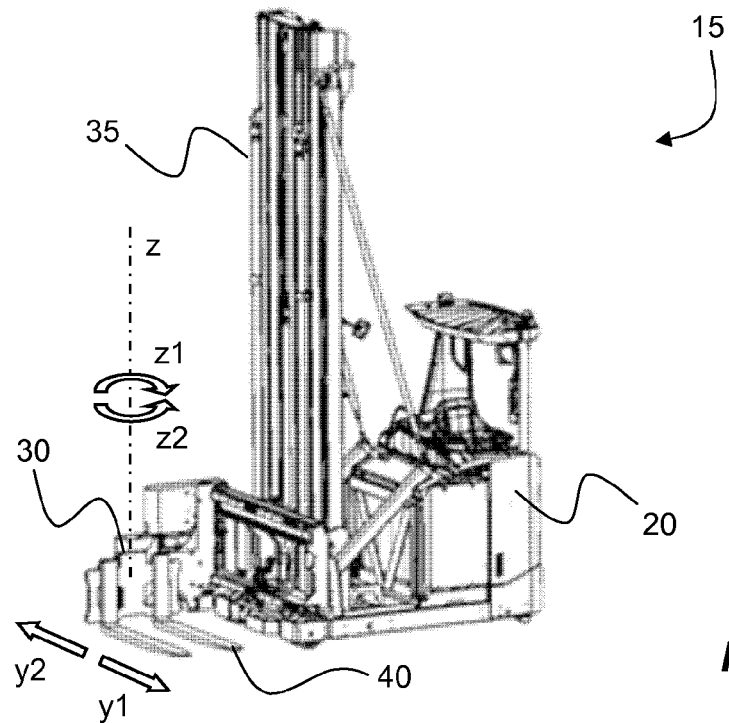


Fig 4

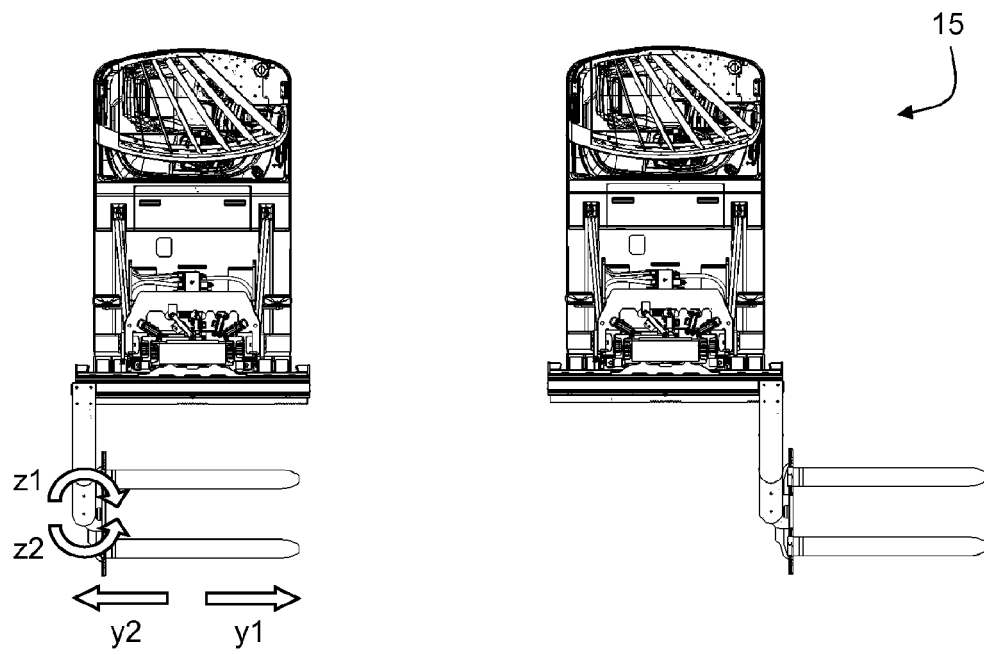


Fig 5

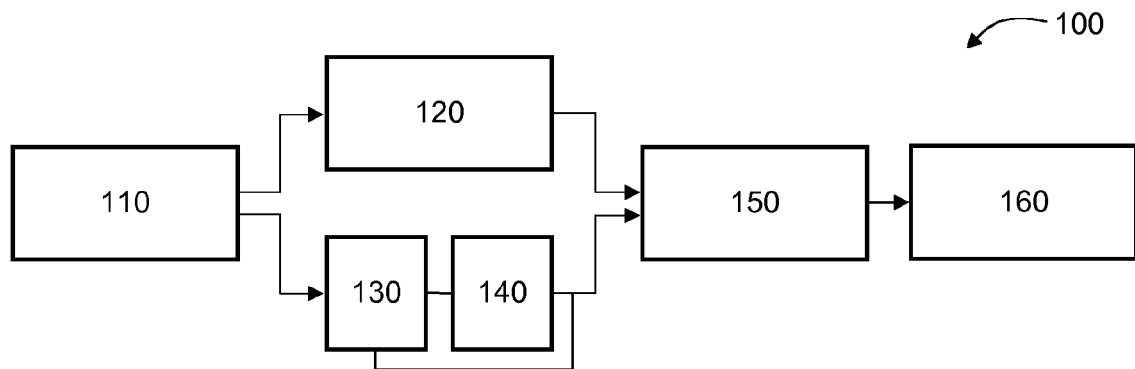
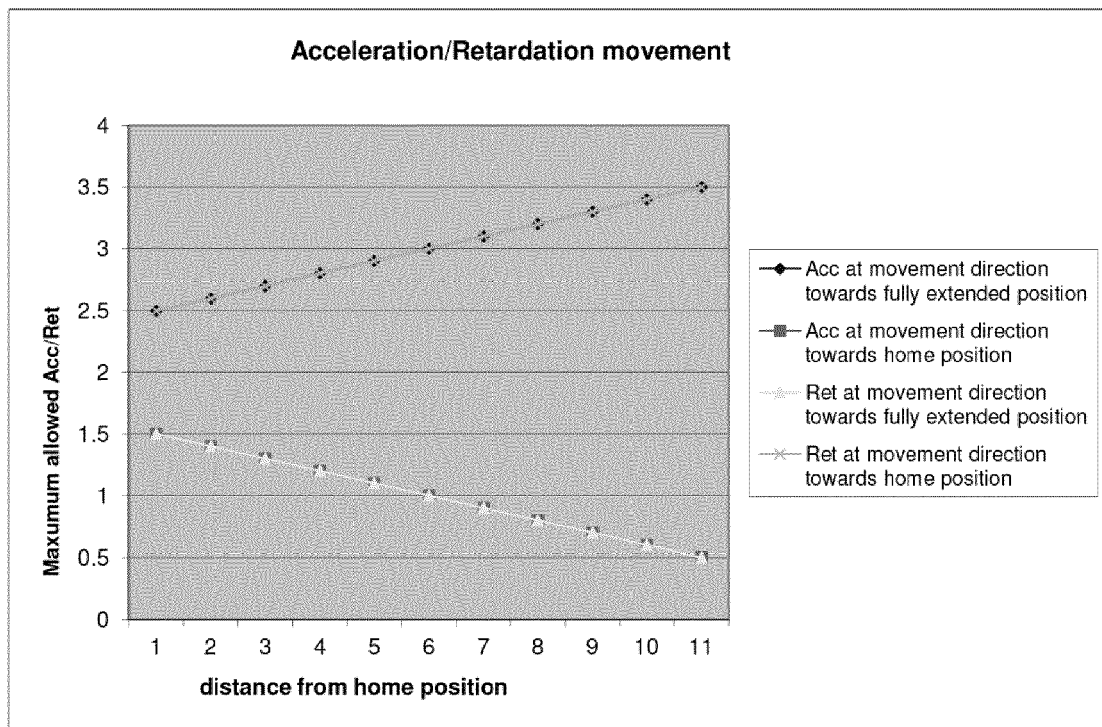


Fig 6

Fig 7





EUROPEAN SEARCH REPORT

Application Number
EP 12 18 4507

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	EP 1 203 745 A1 (STILL WAGNER GMBH & CO KG [DE]) 8 May 2002 (2002-05-08) * the whole document *	1-17	INV. B66F9/24
A	EP 2 447 203 A1 (BT PRODUCTS AB [SE]) 2 May 2012 (2012-05-02) * the whole document *	1-17	
			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 23 November 2012	Examiner Faymann, L
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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23-11-2012

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REFERENCES CITED IN THE DESCRIPTION

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