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(54) Arrangement and method for controlling the position of the forks of an industrial truck

(57) An industrial fork lift truck (1) including an arrangement (14) for controlling the position of the forks of the truck wherein the arrangement (14) comprise sensors (18) and (21) for detecting the height and the angular position of the forks on the mast (8), a shelf selector, a storage in which shelf height positions are stored and a control unit (17) wherein the control unit (17) is arranged to control the adjustment of the height position of the forks on the mast to pre-defined height positions corresponding to a selected shelf. The invention also relates to a method for controlling the position of the forks on the mast of an industrial truck including an arrangement (14), wherein a shelf position is selected; wherein the control unit (17) is configured with one or several pre-defined fork height positions corresponding to shelf position; wherein the control unit (17) controls the adjustment of the position of the forks to the pre-defined fork height positions corresponding to the selected shelf position.

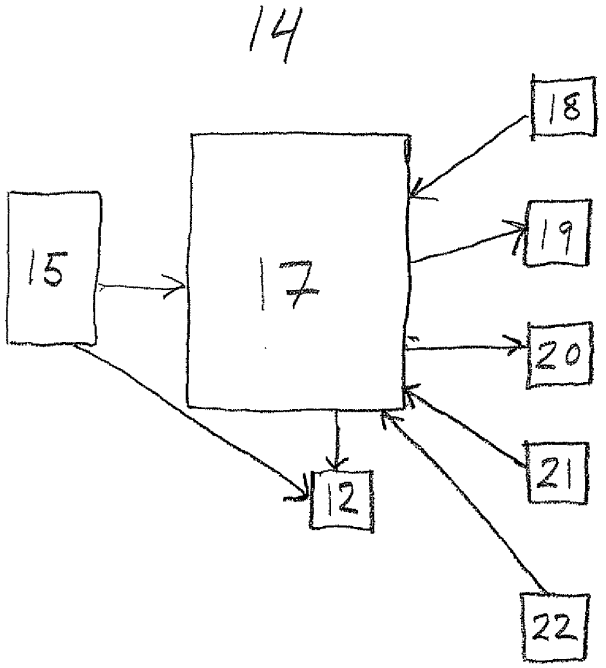

Fig 4

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Description

TECHNICAL FIELD

[0001] The present invention relates to an industrial truck comprising an arrangement for controlling the position of the forks of the truck. The invention also relates to a method for controlling the position of the forks of the truck.

BACKGROUND ART

[0002] In storage magazines goods are normally placed on pallets, which are stored on shelves. Several shelves may be arranged over each other and it is not unusual that the top shelf is located more than ten meters above the ground.

[0003] In order to handle the goods in the magazine industrial trucks are used. An industrial truck for use in a magazine normally comprise a frame on which is arranged a driver's platform or seat, a propulsion system i.e. a motor, one or more drive wheels and load engagement means, such as forks. The forks are normally arranged on a mast so that the forks can be raised to different levels of the shelves. For stability, the truck may also comprise forward support wheels.

[0004] In a normal goods handling operation, the driver of the truck receives an order to pick up a load in the magazine and deliver it to a loading bridge from where a lorry is loaded.

[0005] Having received the pick-up order, the truck driver drives the truck to the specific location of the load. As mentioned above, the load is normally stored on a pallet on one of the shelves in the magazine. At the location, the truck driver raises the forks on the mast of the truck to the position of the shelf where the pallet is located. Thereafter the driver ensures that the forks are level with the pallet. Normally the driver controls by eye sight that the forks are at the correct height and are level with the pallet. Next, the driver moves the truck or the mast forward, whereby the forks are inserted into corresponding grooves in the pallet. The forks are thereafter raised a small distance so that the pallet is lifted above the shelf. The driver then subsequently moves the truck or the mast backwards in order to move the pallet out from the shelf and then lowers the forks to ground level. Finally, the driver tilts the forks upwards. By tilting the forks upwards the weight of load leans on the mast whereby it is secured on the forks and will not move during acceleration or retardation of the truck. The driver then drives the truck to the delivery position.

[0006] A common problem during goods handling with industrial trucks is that the driver has to manually ensure that the forks are at the right height and in the right angular position when engaging a load on a shelf. This is very time consuming since the driver sometimes needs several tries before the forks are in the right position.

[0007] Another problem with manual handling of the fork position is that the driver sometimes forgets to tilt the forks upwards prior to transporting the load to the delivery station. Driving a truck with a non-secured load, thus with the forks in a horizontal position, is hazardous since the load could slide of the forks if the truck is accelerated or braked hastily. The load it self, or persons or equipment in the vicinity of the truck could then be damaged. A very serious scenario would be if a person steps out in front of a truck which is driven with a non-secured load. In this case the driver instinctively brakes the truck to avoid running over the person, however due to the sudden retardation the unsecured load may slide of the forks and could hit the person in front of the truck.

[0008] It is an object of the present invention to provide an industrial truck including an arrangement for controlling the position of the forks of the truck. This object is achieved by the truck according to the invention. It is also an object of the present invention to provide a method for controlling the position of the forks of an industrial truck. This object is met by the method of the present invention.

SUMMARY OF THE INVENTION

[0009] The invention relates to an industrial fork lift truck including an arrangement for controlling the position of the forks of the truck, **characterized in that** the arrangement comprise sensors for detecting the height and the angular position of the forks on the mast, a shelf selector, a storage in which shelf height positions are stored and a control unit, wherein the control unit is arranged to control the adjustment of the height position of the forks on the mast to pre-defined height positions corresponding to a selected shelf.

[0010] The arrangement provides for quick and accurate adjustment of the height position of the forks on the mast of the truck. Thereby is the need for manual control during adjustment of the height of forks minimized which in turn substantially shortens the lifting procedure and provides a secure operation.

[0011] The arrangement may comprise a cycle selector for selecting fork angular positions, wherein the control unit is arranged to control the adjustment of the angular position of the forks on the mast to pre-defined angular positions corresponding to a selected lifting or lowering cycle. Thereby is the need for manual control during adjustment of the angular position of the forks minimized which in turn substantially shortens the lifting procedure and provides a secure operation.

[0012] The control unit may have one or more loops, each loop provides for separate control of parameters such as

height or angular position of the forks. A separate loop may be arranged to control the horizontal position of the forks.

[0013] The arrangement may comprise an on/off-switch connected to the control unit, arranged to be manually actuated. The on/off-switch enables the driver of the truck to manually influence the lifting or lowering operation

[0014] The invention also relates to a method for controlling the position of the forks of an industrial truck including an arrangement according to any one of claims 1 - 4 wherein a shelf position is selected; wherein the control unit is configured with one or several pre-defined fork height positions corresponding to shelf position; wherein the control unit controls the adjustment of the position of the forks to the pre-defined fork height positions corresponding to the selected shelf position. By the method is achieved that the forks of the industrial truck always are in the right height position during the lifting or lowering cycle. This provides for fast and reliable lifting operation.

[0015] In the method a lifting or lowering cycle may be selected; wherein the control unit is configured with one or several pre-defined fork angular positions corresponding to the selected cycle; wherein the control unit controls the adjustment of the angular position of the forks to the pre-defined angular positions. By the method it is possible to ensure that the forks always are in the right angular position during a lifting cycle, whereby a fast and reliable lifting operation is provided. Furthermore, it is possible to ensure that the forks always are in an upward tilted position at the end of the lifting operation whereby the load is secured. This greatly reduces the possibility of damage to persons, goods or equipment in the vicinity of the truck due to slippage of the load.

[0016] Two or more loops may be configured in the control unit; wherein the first loop is configured with one or several pre-defined fork height positions; wherein the second loop is configured with one or several pre-defined fork angular positions. Thereby adjustment of separate parameters, such as fork height and angular position may be achieved.

[0017] According to one alternative, the fork height position and the fork angular position are adjusted alternately to pre-defined positions, starting with the fork height position. Thereby is achieved a secure lifting or lowering operation.

[0018] According to another alternative, the fork height position and the fork angular position are adjusted alternately to pre-defined positions, starting with the fork angular position.

[0019] According to a further alternative, the fork height position and the fork angular position are simultaneously adjusted to pre-defined positions. Thereby is achieved a fast and secure lifting or lowering operation

[0020] Each loop may be configured to stop after having adjusted the position of the forks to a pre-defined position and to await a command before starting to adjust the position of the forks to a next pre-defined position. Thereby is achieved that the forks are in a correct position in each step of the lifting or lowering cycle.

[0021] According to one alternative, the command is a signal from the control unit. An automated lifting or lowering procedure may thereby be achived.

[0022] According to another alternative, the command is a signal from a manually actuated on/off-switch. By this configuration, it is possible for the driver to keep control over the lifting or lowering cycle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Figure 1 illustrates schematically an industrial truck comprising the arrangement according to the invention.

Figure 2 illustrates schematically an industrial truck comprising the arrangement according to the invention in a side view.

Figure 3 is an enlarged view of the industrial truck according to figure 2, showing the means for tilting of the forks.

Figure 4 illustrates schematically the arrangement according to the invention for controlling the height and angular position of the forks of an industrial truck.

DETAILED DESCRIPTION

[0024] Figure 1 describes an industrial truck comprising an arrangement according to the invention. The industrial truck may be a truck with fix mast or a reach truck, having a horizontally movable mast.

[0025] The industrial truck 1 comprises a frame 2 which in its forward part extends into two forward support legs 3 carrying support wheels 4. The frame 2 supports a housing 5 in which an electrical drive motor for propelling a drive wheel and a hydraulic motor for providing power to movable parts on the truck is accommodated (not shown). The housing 5 further accommodates a driver's compartment 6, comprising a seat and controls for driving the truck and actuating parts on the truck. A roof 7 is arranged over the driver's compartment.

[0026] The frame 2 further supports a telescopic lifting mast 8. The mast comprises several segments. The first segment comprises outer two uprights 8.1 and 8.2 of e.g. H-beam shape. The uprights are connected by cross pieces.

A pair of inner uprights 9.1, 9.2, also connected by a cross pieces, are arranged inside the outer uprights. Bearings are provided in contact with the inner and the outer uprights, thus journaling the inner uprights 9.1, 9.2 to the outer uprights 8.1, 8.2. A hydraulic lifting arrangement 10, powered by the hydraulic motor is arranged to lift the inner uprights in order to extend the mast to a desired height.

[0027] The lifting mast 8 may be arranged to be moved horizontally forward and backwards on the support legs 3. The horizontal movement of the mast is accomplished in that the mast is supported on a carriage 11, as described in figure 2, which is journalled in each of the support legs. A hydraulic piston 12, powered by the hydraulic motor, moves the carriage 11 back and fort on the support legs 3. Sensors, such as lasers, bearings or ultrasonic sensors could be arranged in the truck to determine the mast horizontal position.

[0028] Returning to figure 1, the lifting mast 8 further comprises a loading fork 13. The loading fork 13 is journalled in each of the inner uprights 9.1 and 9.2. Means 20, e.g. a chain and pulley system or a hydraulic system, are arranged for adjusting the height of the forks on the mast, e.g. raise or lower the forks. As described in figure 3, the angular position of the forks may be adjusted by means 19 which tilts the loading fork 13. The means 19 for tilting the loading fork 13 may be hydraulic piston arranged between the loading forks 13 and the mast 8.

[0029] According to the invention, the truck further comprises an arrangement 14 for controlling the height and angular position of the loading forks 13 on the mast. The arrangement 14, which is illustrated in figure 4 comprise a driver's interface 15, a control unit 17, a fork angular position sensor 21 and a fork height sensor 18. The driver's interface is connected to the control unit 17. The control unit 17 is connected to the means 20 for adjusting the height of the loading forks 13 and to the means 19 for adjusting the angular position of the forks. The control unit 17 is also connected to the fork angular position sensor 21 and to the fork height sensor 18. The driver's interface is also connected to the means 12 for moving the mast horizontally. The location of each part of the arrangement 14 could be seen in figure 2.

[0030] Since the parts of the control arrangement 14 are known *per se* it is not considered necessary to describe the construction of each part in detail.

[0031] The arrangement functions in the following way, the driver's interface 15 comprises a shelf selector in which the height positions of all the shelves in the magazine are stored. The shelf selector could for example be a keyboard or a touch screen. The driver selects a certain shelf by typing the shelf identification number into the shelf selector. The selection of a shelf configures the control unit 17 with the height positions that the forks should be adjusted to during the lifting of a load to a shelf or the lowering of a load from a shelf.

[0032] The driver's interface 15 also comprises a cycle selector, that enables the driver to select between a lifting cycle and a lowering cycle. The cycle selector is normally a keyboard or a touch screen, which could be integrated in the shelf selector. By "lifting cycle" is meant a lifting of a load from the floor to a shelf and then a lowering of the forks. By "lowering cycle" is meant a rising of the forks to a shelf and a lowering of a load from the shelf to a distance above the floor, e. g. 1 m. By the selection of a lifting or lowering cycle, the control unit 17 is configured for controlling the position of the forks during either a lifting or a lowering cycle. At the beginning of a lifting cycle the truck is in front of a shelf normally with the forks 1 meter above the floor with the a fork angular position of 5°. At the beginning of a lowering cycle the truck is in front of a shelf, normally with the forks 1 meter above the floor with the a fork angular position of 0°. Normally, the forks have the following positions during each cycle:

Step	Lifting cycle	Lowering cycle
1	Fork angular position = 0°	Fork angular position = 0°
2	Fork height position = 0.1 m above selected shelf	Fork height position = selected shelf
3	Fork height position = selected shelf	Fork height position = 0.1 m above selected shelf
4	Fork height position = 1 m above the floor	Fork height position = 1 m above the floor
5	Fork angular position = 5°	Fork angular position = 5°

[0033] The lifting and lowering cycle may also comprise the steps of horizontally moving the forks towards or away from the shelf. These steps may be performed automatically, controlled by the control unit or manually in that the driver actuates a switch that initiates the movement of the forks. The horizontal movement of the forks may be performed by the horizontal movement of the mast.

[0034] The driver's interface 15 further comprises an on/off-switch, which may be a lever or a press button. Normally, the on/off-switch is integrated in the lifting and lowering lever of the truck. The on/off-switch starts the procedure of lifting or lowering the forks after the selection of lifting cycle and shelf height. The on/off-switch also enables the driver to manually influence the lifting cycle. The on/off-switch could be arranged such that it needs to be actuated during the adjustment of fork position. If the switch is not actuated the movement of the forks stops. The driver's interface 15 also comprises a further switch that actuates the hydraulic piston 12 to move the mast 8 horizontally.

[0035] The fork height sensor 18 is arranged to measure the height of the loading forks 13 on the mast 8. The fork height sensor 18 could for example be a journalled sensor which registers markings on the mast. It may also be a laser sensor. The height of the forks is measured with reference to the floor.

[0036] The fork angle sensor 21 is arranged to measure the angular position of the forks. The angular position of the forks is measured with reference to a horizontal plane, such as the floor. For example does an angle of 5° indicate that the loading forks 13 are slightly inclined towards the roof, an angle of 0° indicates that the loading forks 13 are level with the horizontal plane e.g. the floor. The fork angle sensor 21 could for example be a water level or a potentiometer. The angular position of the forks could also be determined by the position of the e.g. hydraulic means, which adjusts the angular position of the forks.

[0037] The control unit 17 is arranged to control the height and angular position of the forks on the mast. The control unit 17 is arranged to receive signals corresponding to a selected lifting or lowering cycle and signals corresponding to a selected shelf height from the driver's interface 15. The control unit 17 is also arranged to receive signals corresponding to the actual position of the fork from the fork height sensor 18 and the fork angle sensor 21. The control unit 17 is further arranged to actuate the hydraulic lifting arrangement 10 for raising the telescopic mast 8, to actuate the means 20 for moving the loading forks 13 on the mast and to actuate the means 19 for adjusting the fork angular position.

[0038] Normally, the control unit 17 is a regulator, which could contain several control loops. A first loop controls the fork height and a second loop controls angular position of the forks. Further control loops could be configured to control the horizontal position of the forks, e.g. by moving the mast horizontally.

[0039] When the control unit 17 receives a signal from the driver's interface which indicates a selected lifting or lowering cycle and a selected shelf height a number of steps are configured in each loop. Each step defines the different position that the forks should have during the selected lifting cycle. The specific position that the forks should have at each step of the lifting cycle is defined by a set point.

[0040] Each loop receives signals from the sensors corresponding to the actual height and angular position of the forks. The first loop receives signals corresponding to actual fork height and is arranged to actuate the means for moving the loading forks 13 on the mast. The second loop receives signals corresponding to actual fork angular position and is arranged to actuate the means for adjusting the fork angular position. In each step of the loop the signals from the sensors are compared with the set point. The means for adjusting fork height and fork angle are then actuated in order to approach the actual position of the forks to the position according to the set point. The step of the loop is repeatedly executed until the actual position of the forks is equal to, or close to, the position according to the set point. Thereafter the next step in the loop is run.

[0041] The loops may be run separately or simultaneously. Each loop could be configured with conditions, for example that the loop should stop after having completed one step and wait until a step in another loop is fulfilled. Another condition could be that the loops should stop after having completed a step step and wait for a manual command from the driver before proceeding to the next step in the cycle. The signal could be a manual command e.g. the actuation of the on/off switch. According to one alternative, the driver actuates the on/off switch after the completion of one step in order to proceed with a next step. According to another alternative, the driver keeps the on/off-switch actuated during parts of, or the whole cycle and the steps proceeds one after another, alternately or simultaneously, as long as the on/off-switch is actuated.

[0042] Following is an example of the method for controlling the movement of the forks during the lowering of a load form a shelf, wherein the control unit runs the loops alternately, thus first one step in the first loop is run, then one step in the second loop is run.

[0043] In the case of a lowering cycle the truck normally arrives at the appropriate shelf with the forks at a height position of 1 m above the ground and with an optional angular position of e.g. 0° or 5°.

[0044] First the driver selects a shelf and a lowering cycle by actuating the appropriate switch on the drivers interface. The lowering cycle comprise the following steps:

step 1, setting fork angular position to 0°;
step 2, setting fork height to the height of a specific shelf
step 3, setting fork height to a distance of e.g. 0.1 m above shelf
step 4, setting fork height to a distance of e.g. 1 m above the floor;
step 5, setting fork angular position to 5°.

[0045] By the selection of the lowering cycle and the fork height the loops in the control unit are configured with the following set points:

Step	Loop 1: fork angular position	Loop 2: fork height position
1	0°	height of the selected shelf

(continued)

Step	Loop 1: fork angular position	Loop 2: fork height position
2	0°	0.1 m above the selected shelf
3	0°	1 m above the floor
4	5°	1 m above the floor

[0046] In this embodiment each loop is configured with the condition that the loop should stop when the position of the forks is equal to the set point configured in that step and that the other loop should be run when the driver has actuated the on/off-switch.

[0047] The driver then actuates the on/off-switch. By actuation of the on/off-switch the first step in the first loop in the control unit 17 is run until the fork angular position is set to 0°, thus level with the ground. The loop then stops. The driver actuates the on/off-switch again and the first step of the second loop in the control unit 17 is run whereby the forks are raised until they are at the height of the selected shelf. Generally at a position where the forks may be inserted in the corresponding grooves in a pallet, located on the shelf.

[0048] The driver then moves the forks forward to insert them in the corresponding grooves in the pallet. In a reach truck this may be achieved by the actuation of the hydraulic piston 12 is to move the mast horizontally on the forward support legs of the truck. In a fix mast truck, the driver moves the truck forward.

[0049] The driver then again actuates the on/off-switch, whereupon the second step in the first loop is run. In this case the forks are already in a horizontal position and their position is therefore not changed. The driver therefore actuates the on/off-switch again, whereupon the second step in the second loop is run until the forks are supporting the load in a position of e.g. 0.1 m above the shelf.

[0050] The driver then moves the forks backwards so that the pallet is supported by the loading forks 13 in a position outside the shelf.

[0051] The driver then actuates the on/off-switch, whereupon the third step in the first loop is run. Since the forks still are in a horizontal position their position is not changed. The driver therefore actuates the on/off-switch again, whereupon the third step in the second loop is run until the height of the forks are at distance of e.g. 1 m above the ground.

[0052] The driver then again actuates the on/off-switch whereupon the fourth step of the first loop is run until the angular position of the forks is 5° with respect to the horizontal plane whereby the first loop ends. The driver actuates the on/off-switch again, whereupon the fourth step in the second loop is run, since the forks already are at height of 1 m above the floor the position of the forks is not changed and also the second loop ends.

The forks are now slightly tilted upwards and the load leans against the mast of the truck. The load is thereby secured and the driver may transport the load to the delivery station.

[0053] As an alternative to the aforementioned procedure all or some of the steps of the two loops may proceed alternately, immediately after each other as long as the driver keeps the on/off-switch actuated. For example during the last part of the lowering cycle, whereby the driver keeps the on/off-switch actuated whereupon the fourth step of the first loop is run until the angular position of the forks is 5° with respect to the horizontal plane whereby the first loop ends. Since the on/off-switch is actuated the fourth step in the second loop is immediately run, since the forks already are at height of 1 m above the floor the position of the forks is not changed and also the second loop ends.

[0054] According to an alternative embodiment of the inventive method, the adjustment of fork height and fork angle could be performed simultaneously in the same step of the lifting or lowering cycle.

[0055] Following is an example of a method wherein the controlling of fork height and fork angle is performed simultaneously during the lowering of a load from a shelf.

[0056] In a first step the driver selects a shelf and lowering cycle on the drivers interface. The loops are configured with set points as described above. Each loop is also configured with the condition to wait until both loops have completed one step and to simultaneously proceed with the next step when the driver actuates the on/off-switch.

[0057] The driver then actuates the on/off-switch. By actuation of the on/off-switch the first step of the first loop and the first step of the second loop are run simultaneously until the fork angular position is 0° and the forks are at the selected shelf height whereby the loops stops.

[0058] The driver then moves the forks horizontally as described above until the forks are inserted in the corresponding grooves in the pallet

[0059] The driver then actuates the on/off-switch again whereupon the second steps of first each loop are run. Since the forks already are in a horizontal position, only the means for adjusting the height position of the forks actuated until the forks are at a distance of e.g. 0.1 m above the selected shelf height.

[0060] The driver then moves the forks backwards as described above so that the pallet is supported by the loading forks 13 in a position outside the shelf.

[0061] The driver then actuates the on/off, switch whereby the third steps of each loop are run until the angular position of the loading forks is 5° with respect to the horizontal plane and the forks are at a distance of 1 m above the ground and the loops ends. The forks are slightly tilted upwards and the load leans against the mast of the truck.

[0062] The load is thereby secured and the driver may transport the load to the delivery station.

[0063] Although particular embodiments have been disclosed herein in detail, this has been done for purposes of illustration only, and is not intended to be limiting with respect to the appended claims. The disclosed embodiments can also be combined. In particular, it is contemplated by the inventors that various substitutions, alterations, and modifications may be made to the invention without departing from the spirit and the scope of the invention as defined by the claims. For instance could various types of sensors for measuring fork height and fork angular position and different types of control units for regulating the height and angle of the forks be used. It is also possible to use various of techniques and algorithms in the control unit to regulate the position of the movable parts. Various conditions could be set in the control unit for example that the truck may not be driven until the forks are in a backward tilted position.

Claims

1. An industrial fork lift truck (1) including an arrangement (14) for controlling the position of the forks of the truck **characterized in that** the arrangement (14) comprise sensors (18) and (21) for detecting the height and the angular position of the forks on the mast (8), a shelf selector, a storage in which shelf height positions are stored and a control unit (17) wherein the control unit (17) is arranged to control the adjustment of the height position of the forks on the mast to pre-defined height positions corresponding to a selected shelf.

2. The industrial truck according to claim 1 wherein the arrangement (14) comprise a cycle selector for selecting fork angular positions, wherein the control unit (17) is arranged to control the adjustment of the angular position of the forks on the mast to pre-defined angular positions corresponding to a selected lifting or lowering cycle.

3. The industrial truck according to claim 1 or 2 wherein the control unit (17) has one or more loops.

4. The industrial truck according to claim 1-3 wherein the arrangement comprises an on/off-switch connected to the control unit (17), arranged to be manually actuated.

5. A method for controlling the position of the forks on the mast of an industrial truck including an arrangement (14) according to any one of claims 1 - 4 wherein a shelf position is selected; wherein the control unit (17) is configured with one or several pre-defined fork height positions corresponding to shelf position; wherein the control unit (17) controls the adjustment of the position of the forks to the pre-defined fork height positions corresponding to the selected shelf position.

6. The method according to claim 5 wherein a lifting or lowering cycle is selected; wherein the control unit (17) is configured with one or several pre-defined fork angular positions corresponding to the selected cycle; wherein the control unit (17) controls the adjustment of the angular position of the forks to the pre-defined angular positions.

7. The method of claim 6 wherein two or more control loops are configured in the control unit (17); wherein the first loop is configured with one or several pre-defined fork height positions; wherein the second loop is configured with one or several pre-defined fork angular positions.

8. The method according to claim 6 or 7 wherein the fork height position and the fork angular position alternately are adjusted to pre-defined positions, starting with the fork height position.

9. The method according to claim 6 or 7 wherein the fork height position and the fork angular position alternately are adjusted to pre-defined positions, starting with the fork angular position.

10. The method according to claim 6 or 7 wherein the fork height position and the fork angular position simultaneously are adjusted to pre-defined positions.

11. The method according to claim 7-10 wherein each loop is configured to stop after having adjusted the position of the forks to a pre-defined position and to await a command before starting to adjust the position of the forks to a next pre-defined position.

12. The method according to claim 11 wherein the command is a signal from the control unit (17).

13. The method according to claim 11 wherein the command is a signal from a manually actuated on/off-switch.

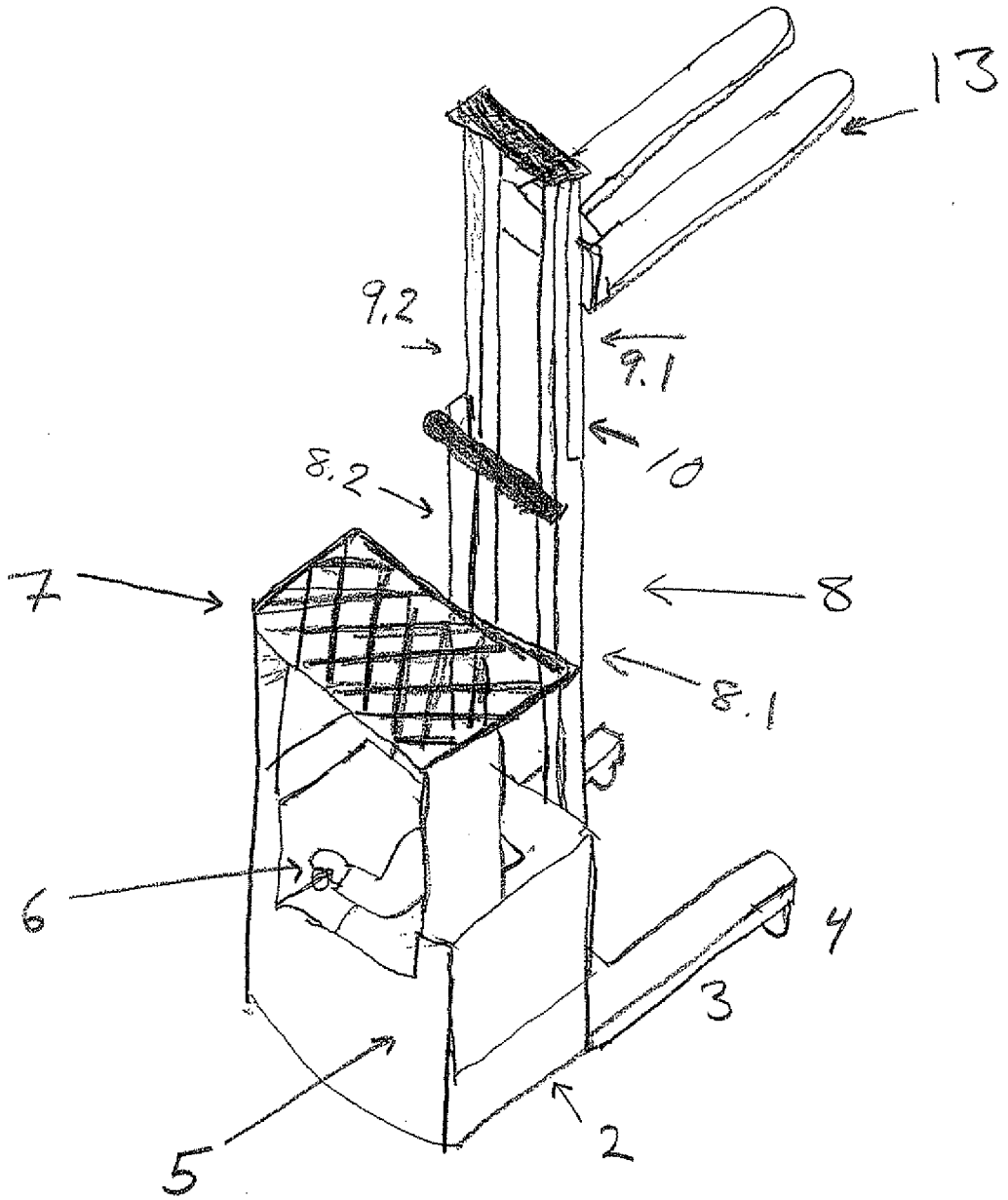

Fig 1

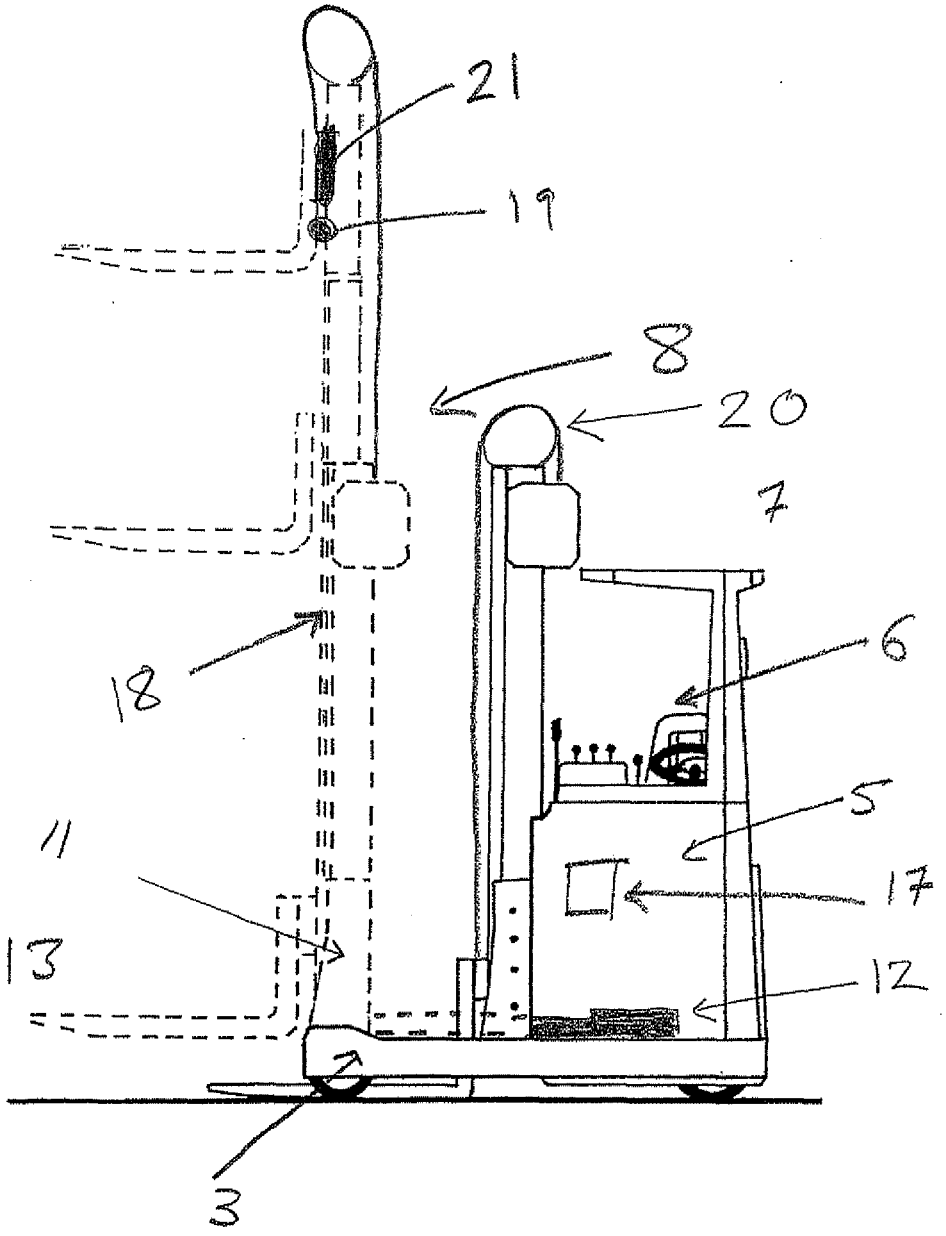

Fig 2

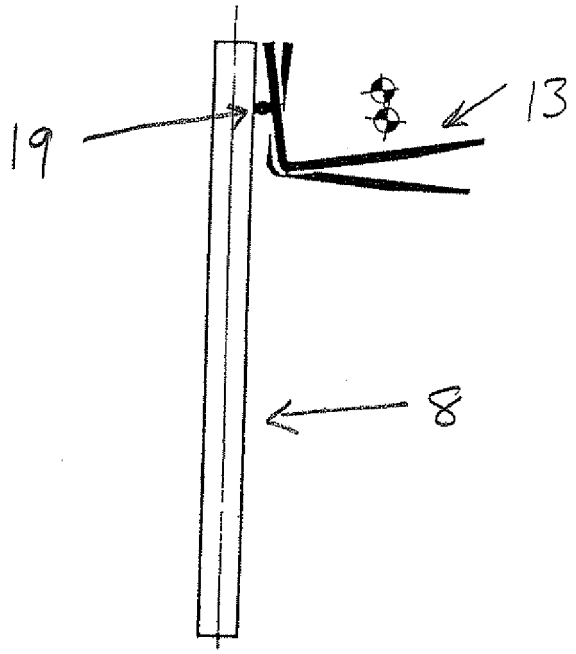

Fig 3

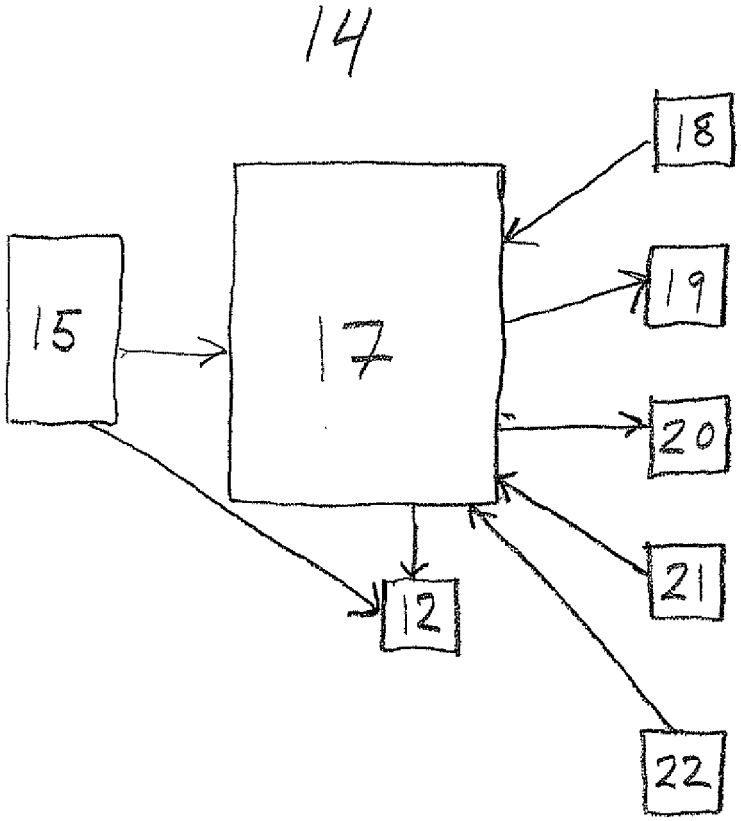

Fig 4

Europäisches Patentamt
European Patent Office
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EUROPEAN SEARCH REPORT

Application Number
EP 08 15 6534

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	GB 2 366 784 A (NIPPON YUSOKI CO LTD [JP]) 20 March 2002 (2002-03-20) * abstract; figures 1-8,29-47 * * page 1 - page 5 * * page 20 - page 24 * * page 114 - page 125 *	1-13	INV. B66F9/08 B66F17/00 B66F9/20
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 October 2008	Verheul, Omiros

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 08 15 6534

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