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

(11) **EP 2 527 288 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
28.11.2012 Bulletin 2012/48

(51) Int Cl.:
B66F 9/20 *(2006.01)*

(21) Application number: **11167826.4**

(22) Date of filing: **27.05.2011**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

(71) Applicant: **Atlet AB**
43582 Mölnlycke (SE)

(72) Inventors:
- **Petersson, Håkan**
  412 75 GÖTEBORG (SE)
- **Bengtsson, Mats**
  435 32 MÖLNLYCKE (SE)
- **Callderyd, Jan**
  553 39 JÖNKÖPING (SE)

(74) Representative: **Lind, Urban Arvid Oskar**
Awapatent AB
Södra Hamngatan 37-41
404 28 Göteborg (SE)

(54) Fork lift truck with automatic lift height control

(57) A fork lift truck is disclosed, comprising: a mast carrying forks which can be moved in height between a lowered position and desired raised positions; an operator control to be manually operated to move said forks; a fork height sensor; and a lift controller system. The lift controller system comprises: a memory including a plurality of pre-stored shelf heights and a controller. The controller is arranged to receive a lifting signal from the operator control for lifting forks of the industrial truck, thereby entering a manually controlled lifting mode, to determine that a condition for a lift stop assistance mode has been fulfilled, thereby entering a lift stop assistance mode, and to automatically reduce, in said lift stop assistance mode, the lifting signal from said operator control so that the lifting of said lifting forks stops at a height corresponding to the next pre-stored shelf height. A corresponding method is also disclosed.

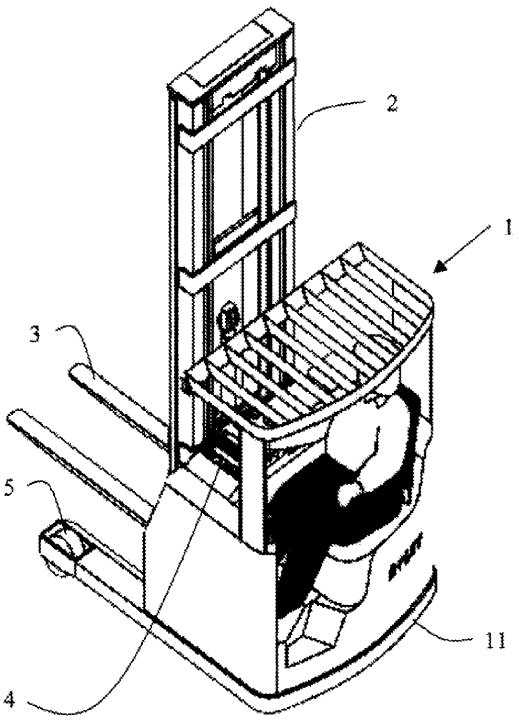

Fig. 1

EP 2 527 288 A1

Description

Technical Field

[0001] The present invention relates to a fork lift truck and to a method for controlling a fork lift truck.

Background of the Invention

[0002] Material handling operations commonly involve storing/depositing and retrieval of loads at or from warehouse racks having vertically stacked shelves, requiring that an operator control a truck lifting mechanism to lift or lower different loads to specified heights. Conventionally, this type of industrial vehicle has a multi-level mast provided on its vehicle body, and a carriage having a fork is so provided as to be liftable along the mast. At the time of performing a load retrieval or load deposition at a high place in a rack, for example, a driver operates an operator control, such as a lift lever, to protract or retract the multi-level mast by hydraulic driving to move the forks upward along the mast to position the forks to a pallet in the rack or a shelf surface. At this time, the driver must manipulate the lift lever while checking with the eyes if the forks are positioned to holes in the pallet or a position above the shelf surface by looking up at a high place (e.g., 3 to 6 meters) from below. It is however difficult to determine if the forks and a pallet or the like are positioned with the eyes by looking up at a high place, and even a skilled person needs time for this positioning.

[0003] Also, the consequences of misjudging the height can be severe. Where the fork is too high or too low relative to the retrieve position it may engage the goods or the shelf rather than the pallet. The fork may damage the goods, the shelf, or the pallet, or it may push the pallet and goods off the opposite side of the shelf. Where the fork is too high or too low relative to the store height, the goods on the pallet may be jammed into the shelf and the top of the goods may hit the shelf above the selected shelf. This may damage the goods or the shelf, or the goods may fall off the pallet onto the floor, the truck, or the operator.

[0004] Many modern lift trucks are capable of lifting loads far above elevations where the forks are clearly visible to an operator stationed at the base of a truck, so that storing and retrieval of loads has been undesirably slowed down and sometimes made unsafe. Increased handling may be accomplished with greater safety, if improved means are provided to enable an operator to lift or lower loads to designated heights, and provision of such means is a general object of the invention.

[0005] To aid the operator in this cumbersome and tedious task, it is known to arrange height sensors on the truck, to provide the operator with information about the current lift height. Such height sensors are e.g. disclosed in US 5 011 358, US 5 995 001, US 6 533 076 and US 7 266 904.

[0006] Some attempts to further automate this procedure has been done over the years. For example, it is known to provide a camera at the forks, to provide a visualization of the shelves. Further, US 7 219 769 discloses a system where a camera is used to identify markers arranged on the shelves. Further, US 4 547 884 discloses a system where the operator can input or retrieve a desired height on a keyboard, and then be assisted in reaching this height.

[0007] However, these known automated systems have several drawbacks. First of all, these known systems are generally relatively costly to introduce and maintain. Still further, these systems generally requires additional operation steps to be performed, such as inputting data on a keyboard, which makes the processes tedious and cumbersome. Still further, in most known automated systems the operator is left with little or no control over the lifting operation, which is often experienced as uncomfortable, and may even lead to hazards, should any error occur.

[0008] Therefore, there is still a need for improvement within this area.

Summary of the Invention

[0009] In view of the above, a general object of the present invention is to provide an improved fork lift truck, and a corresponding method for operating such a fork lift truck, at least partly alleviating the above-discussed problems. This and other objects are achieved through a fork lift truck and a method for controlling such a fork lift truck according to the appended claims.

[0010] According to a first aspect of the invention there is provided a method for controlling a fork lift truck, comprising the steps of:

providing at plurality of pre-stored shelf heights;
receiving a lifting signal from an operator control for lifting forks of the industrial truck, thereby entering a manually controlled lifting mode;
determining that a condition for a lift stop assistance mode has been fulfilled, thereby entering a lift stop assistance mode;
automatically reducing, in said lift stop assistance mode, the lifting signal from said operator control so that the lifting of said lifting forks stops at a height corresponding to the next pre-stored shelf height.

[0011] The manually controlled lifting mode is a mode where the lifting operation is controlled directly by the operator control in a conventional fashion. The manually controlled lifting mode is preferably a default mode, which is activated unless the conditions for the lift stop assistance mode are fulfilled.

[0012] In the context of the present application, "next pre-stored shelf height" is used to indicate the closest of the pre-stored shelf heights in the upward direction which has not yet been reached by the forks.

[0013] Hereby, a very intuitive and easy to operate pro-

cedure is obtained. The user uses the operator control in a conventional manner, lifting the fork by manual control to a position relatively close to the desired height. At this position, the controller enters the lift stop assistance mode, as soon as it has been determined that the condition for this has been fulfilled, and the system automatically and in a controlled fashion arrives and stops at the desired position.

[0014] Thus, with this system, it becomes very easy for the operator to find the exact intended height. At the same time, operation can be performed at high speed, and in a very convenient and intuitive way. The system is also cost-efficient, since it can be realized by means of a controller, such as a conventional processor, connected to a memory. Thus, there is e.g. no need for any cameras, and corresponding wiring.

[0015] The step of determining that a condition for the lift stop assistance mode has been fulfilled may be achieved in various ways. According to one embodiment, fulfillment of this condition is made manually by the operator, Thus, a determination can hereby be made that a manually operated switch is in an activated state. Such a manually operated switch may e.g. be arranged in the form of a push button or a lever switch, and can e.g. be arranged on the operator control used for the lifting action, to be activated with one of the fingers on the hand gripping the operator control. Hereby, the user may, when coming close to a desired level, activate the switch, and thereby activating the lift stop assistance mode.

[0016] According to another line of embodiments, fulfillment of this condition is obtained in an automated fashion. In this case, the step of determining that the condition for the lift stop assistance mode has been fulfilled preferably comprises determination that the lifting signal has been reduced to a level lower than a threshold value. Hereby, the operator does not need to use any other controls and actuators apart from the ordinary operator control, such as a lift lever, which is also used more or less in the same way as in a purely manually controlled system. Hereby, the productivity of the truck and the operator are increased. Still further, the risk of errors is reduced, both as a result of the risk of arriving at an erroneous height being alleviated, and since the operator interface is simple and intuitive.

[0017] Other ways of obtaining fulfillment of the condition to activate the lift stop assistance mode are also feasible. Further, it is also possible to use a combination of the two embodiments discussed above, wherein the lift stop assistance mode can be invoked both by manual operation of a switch and by passing one or several threshold levels.

[0018] By "lift" and "lifting" is in the context of this application meant both raising and lowering of the forks. It may be possible to use the above-discussed method both for raising and lowering, or solely for lowering of the forks. However, preferably the lift stop assistance mode will only become activated during upward movement of the forks, i.e. during raising.

[0019] The pre-storing of the shelf heights may be provided by means of retrieving said height levels from a warehouse database, and store it in a memory on-board the truck. Alternatively, the heights may be determined and stored during an initialization and calibration process of the truck. Any number of shelf height levels may be used. However, preferably the pre-stored shelf heights are separated from each other by at least 50 cm, and preferably at least 60 cm.

[0020] An alarm signal may be produced upon entry of the lift stop assistance mode. This alarm signal may e.g. be used to issue a notification on a display, informing the operator of the fact that the lift stop assistance mode has been activated. This message may either be in writing, or by flashing of the display, or a combination of the two. Alternatively or additionally, the alarm signal may be used to generate a sound, such as one or several beeps or the like.

[0021] A display is preferably provided to be visible by the operator. The display is preferably arranged to display information related to at least one of: the working mode of the controller, the present height of the forks, the height of the next pre-stored shelf height and the level number of the next pre-stored shelf height. Most preferably, several or all of these items of information are displayed.

[0022] The threshold value at which the lift stop assistance mode is activated is preferably in the range 50-90% of a maximum lifting signal, and most preferably in the range 65-85% of the maximum lifting signal. Preferably, the threshold value is set to 70, 75 or 80%. By "maximum lifting signal" is here meant the electric signal provided by the operator control. The output signal provided by the operator control may be linearly correlated to the movement of the operator control, but the output signal may also be non-linearly correlated to the movement of the operator control. By having such a relatively high threshold value, the lifting operation can be performed in the manually controlled lifting mode as long as the threshold value is not exceeded.

[0023] Further criteria may be required to be fulfilled when using the threshold condition. The lift stop assistance mode may, when this type of condition is used, e.g. only be activated when the operator control is first used to generate a high speed signal exceeding the threshold value, such as full speed, and then subsequently lowered beneath said threshold value. Additionally or alternatively, the lift stop assistance mode may be activated only when it is determined both that the lifting signal is below the threshold value, and that the current height level of the forks is within a predetermined distance from the next pre-stored shelf height, i.e. the current height level of the forks is within a lift stop assistance window. This window may start at a distance from the pre-stored shelf height being in the range 20-1000 mm from the next pre-stored shelf height, and most preferably in the range 400-800, such as at a distance of 700 mm. Further, the window may extend all the way up to the pre-stored shelf height,

or may end a small distance before the pre-stored shelf height, such as a few centimeters before the pre-stored shelf height. All the windows may have the same size. However, windows of different lengths may be used for different pre-stored shelf heights. For example, it is possible to use larger windows when the distance between consecutive pre-stored shelf height is longer, and smaller windows when the distance between consecutive pre-stored shelf heights is smaller. In case the lift stop assistance mode is also useable to assist in reaching both retrieve heights and store heights, as is discussed in more detail in the following, it is also possible to have a second window in which the lift stop assistance mode may be maintained or re-activated for reaching this other position. For example, the first window may cover a distance beneath a pre-stored retrieve level, and the second window may cover the distance between the pre-stored retrieve level and the corresponding store level.

[0024] As soon as any of the one or several criteria of the condition for the lift stop assistance mode fails to be satisfied, such as the manually operated switch no longer being activated, the lift signal no longer being beneath the threshold value and/or the current lift height of the forks no longer being within a valid window, the manually controlled lifting mode is preferably re-activated.

[0025] Thus, the method further preferably comprises the step of determining, when in said lift stop assistance mode, that the lifting signal from said operator control has been raised to a level exceeding said threshold level, and thereby re-entering said manually controlled lifting mode. Thus, even though the lift stop assistance mode has been activated, the operator may still return to the manually controlled lifting mode by again operating the operator control to generate a lifting signal exceeding the threshold level. This is e.g. advantageous if the lift stop assistance mode has inadvertently been entered at a too low height level.

[0026] Similarly, the method further preferably comprises the step of determining, when in said lift stop assistance mode, that the lifting signal from said operator control has been lowered to zero, and thereby re-entering said manually controlled lifting mode. Hereby, the safety of the system is further improved, since it means that if the operator control is used to indicate that no lifting movement is desired, e.g. by releasing the operator control, the lifting movement will immediately come to a halt. Alternatively, lowering the lifting signal from the operator control to zero may be used to immediately halt the lifting action, but maintaining the lift stop assistance mode, e.g. until further actions have been taken to re-enter the manually controlled lifting mode, and/or until a predetermined time has elapsed.

[0027] In the lift stop assistance mode, the lifting signal is preferably first reduced to a first reduced maximum level, and, at a certain distance from the next pre-stored shelf height, is further reduced to a second reduced maximum level. Hereby, a smooth and controlled reduction of the lifting speed is obtained. The reduction may also comprise more than two steps, such as three or more steps. The reduction may also comprise a infinity of reduction steps, corresponding to a gradual continuous reduction of the reduced maximum level.

[0028] The first reduced level may e.g. correspond to a level within the range 40-60% of the maximum lifting signal, such as 50%. The second reduced level may e.g. correspond to a level within the range 20-30% of the maximum lifting signal, such as 25%. Preferably, the first reduced level is initiated at a distance within the range of 20-1000 mm from the next pre-stored shelf height, and most preferably in the range 400-800, such as at a distance of 700 mm. The distance at which the first reduced level is initiated may correspond to the distance at which the first window starts. The second reduced level is preferably initiated at a distance within the range 5-100 mm from the next pre-stored shelf height, and most preferably in the range 20-60 mm, such as at a distance of 30 mm.

[0029] The automatically controlled reduced speed levels may be used instead of the actual speed level provided by the operator control. However, preferably, the automatically controlled reduced speed levels are used as a maximum value for the speed signal, whereby the real speed signal will be the lowest of the actual speed signal received from the operator control and the automatically activated reduced speed signal. Thus, in the lift stop assistance mode, the lifting signal is preferably reduced to a level being the lowest of a reduced maximum lifting level and the actual lifting signal provided by the operator control.

[0030] The intended next shelf level at which the forks are to be positioned generally differs between a situation when goods are to be stored/deposited, and when goods are to be retrieved/picked. This is e.g. the case where pallets are used. In the first situation, the pallet rests on the shelf, and an adequate clearing is necessary for insertion of the forks. In the latter situation, the forks need to be slightly higher, to allow a clearance between the pallet and the shelf for insertion onto the shelf. The height difference between these positions can typically be a few centimeters, such as 5 cm.

[0031] The pre-stored shelf heights in the system may be either store levels, retrieve levels or both. In case only store levels or retrieve levels are stored, the system may automatically adjust these levels, e.g. by reducing the store level by a predetermined measure to receive a retrieve level, and vice versa. However, it is also possible to use only one level, e.g. a store level, whereby the user may manually slightly adjust the height of the forks after having stopped at the intended height to reach the other position.

[0032] However, in a preferred embodiment, the method further comprises the step of determining whether there is a load on the forks, and based on this determination, decide whether the next shelf height is a store level or retrieve level. Various ways are feasible for the system to determine whether there is a load on the forks, and thus, whether a store position or a retrieve position

is desired. For example, this may be achieved by providing an additional operator control, such as a key, upon which the operator may select whether storing or retrieving is intended. Alternatively, a load sensor or the like may be used, which can sense whether there is any load on the forks, and if so selecting a storage height, or if there is no load, and if so selecting a retrieval height. To this end, it is e.g. possible to use a weight sensor, sensing the weight of any load being placed on the forks. Additionally or alternatively, an optical sensor may be used. Other sensors for determining whether there is any load on the forks are also feasible, as is per se known in the art.

[0033] According to another preferred embodiment, the method comprises the additional step of maintaining the lift stop assistance mode even after the stopping of the lifting of said lifting forks at the height corresponding to the next pre-stored shelf height, said level being a store level or retrieve level, and upon a further activation of the operator control automatically proceed with the lifting action to the corresponding retrieve level or store level, respectively.

[0034] The further activation of the operator control can e.g. be to provide a lifting signal in the direction of the corresponding level. Preferably, the further action of the operator control provides a lifting signal lower than the above-discussed threshold level, or lower than another predetermined threshold level (which is then preferably lower than the first discussed threshold level). For example, this maintaining of the lift stop assistance mode may, as discussed above, be obtained by still providing a lifting signal beneath the threshold value, and by being in the second window. As before, the lift stop assistance mode can, also in this situation, preferably be aborted, and the manually controlled lifting mode re-entered, e.g. by providing a lifting signal exceeding the threshold level. Further, the manually controlled lifting mode will preferably be re-entered if the operator control is operated to proceed with the lifting after the second stop, i.e. outside the second window.

[0035] Hereby, the pre-stored shelf heights can e.g. be retrieve levels. After having stopped at this level, the operator may gently operate the operator control, whereby the forks will proceed to the store level.

[0036] The above-discussed method of proceeding with a second stop at a corresponding retrieve or store level is highly advantageous. First of all, it provides a semi-automatic way of exactly arriving at both the retrieve level and the store level. Further, it may also be used when retrieving gods from the shelves. Hereby, the forks may initially be lifted to the retrieve level. Thereafter, the forks may be inserted under the gods to be lifted, and thereafter, the lifting operation may proceed with a lifting to the store level, in which the gods may be retracted from the shelves. Hereby, automation is achieved both in the first lifting operation, where the forks are lifted to the operative position to be inserted under the gods, and also in the second lifting operation, where the gods is to be lifted in the shelve compartment. Due to the automation of this second lifting operation, there is less risk of damaging the gods by lifting it too high, and into the overlying shelf. It also enables the possibility of using more compact shelf structures, which provides a more efficient use of the storage space.

[0037] According to a second aspect of the invention, there is provided a fork lift truck comprising:

- a mast carrying forks which can be moved in height between a lowered position and desired raised positions;
- an operator control to be manually operated to move said forks;
- a fork height sensor; and
- a lift controller system comprising:
  - a memory including a plurality of pre-stored shelf heights;
  - a controller arranged to receive a lifting signal from the operator control for lifting forks of the industrial truck, thereby entering a manually controlled lifting mode, to determine a condition for a lift stop assistance mode has been fulfilled, thereby entering a lift stop assistance mode, and to automatically reduce, in said lift stop assistance mode, the lifting signal from said operator control so that the lifting of said lifting forks stops at a height corresponding to the next pre-stored shelf height.

[0038] By means of this aspect of the invention, similar advantages and possible embodiments as discussed above in relation to the first aspect are obtainable.

[0039] Further embodiments and advantages of the present invention will become apparent from the following detailed description of presently preferred embodiments of the invention.

Brief description of the drawings

[0040] In the following, embodiments of the present invention will be described in detail, with reference to the accompanying, exemplifying drawings on which:

- Figure 1 is a perspective view of a fork lift truck according to the present invention.
- Figure 2 is a schematic view of the lifting system of the fork lift truck in Fig.1.
- Figure 3 is a schematic view illustrating the lifting system of Fig. 2 in a warehouse environment.
- Figure 4 is a schematic view illustrating a control loop to be executed by the controller to determine which mode to use.

Detailed description of preferred embodiments

[0041] Referring now to Fig. 1, there is shown a perspective view of an industrial fork lift truck 1. The fork lift

truck 1 comprises a frame 11, to which are mounted a mast 2, and preferably a telescoping mast, for lifting of forks 3, an operator control station comprising an operator control 4, two non-steerable wheels 5, and a drive wheel (not visible in fig 1). By means of a lifting system, the forks carried by the mast can be moved in height between a lowered position and desired raised positions.

[0042] Even though Fig. 1 illustrates a specific example of a fork lift truck, it is to be acknowledged by the skilled reader that the load lifting system as will be discussed in the following may also be used on many other types of fork lift trucks.

[0043] Referring now to Fig. 2, a block diagram of the lifting system of the lift truck 1 in Fig 1 is illustrated.

[0044] The lift controller system comprises a control 21, which receives operator lift signals from an operator control 4, such as a lift lever, a joystick or the like. Based on these operator lift signals, the lift motor control provides command signals to control a lift motor 22 which is connected to a hydraulic circuit including a pump 23 for driving the forks 3 along the mast 2, thereby moving the load up or down. In some applications, the mast 2 can be a telescoping mast, whereby additional hydraulic circuitry may be provided to raise or lower the mast 2 as well as the forks 3.

[0045] In addition, the lift controller system comprises a fork height sensor 26, arranged to determine the current height position of the forks. Such height sensors are per se well-known in the art, and examples of such sensors are e.g. disclosed in US 5 011 358, US 5 995 001, US 6 533 076 and US 7 266 904, said documents hereby incorporated by reference. The fork height sensor is connected to the lift controller, and provides information of the current height position to the controller.

[0046] Further, the lift controller system comprises a memory 25 including a plurality of pre-stored shelf heights.

[0047] The lift controller system is arranged to operate in two different modes, a manually controlled lifting mode, wherein the lifting is controlled solely by the operator control 4, and a lift stop assistance mode.

[0048] Switching from the manually controlled lifting mode, which is the default mode, to the lift stop assistance mode occurs upon determination that a condition to this effect is fulfilled. The fulfillment of this condition can be obtained in an automated fashion, and preferably by determining that the lifting signal has been reduced to a level lower than a threshold value. Such embodiments will be discussed in more detail in the following.

[0049] However, additionally or alternatively, fulfillment of this condition can be made manually by the operator, Thus, a determination can hereby be made that a manually operated switch is in an activated state. Such an manually operated switch may e.g. be arranged in the form of a push button or a lever switch, and can e.g. be arranged on the operator control used for the lifting action, to be activated with one of the fingers on the hand gripping the operator control. For example, a push button to be operated by the thum may be provided at the top of the lift lever. Hereby, the user may, when coming close to a desired level, activate the switch, and thereby activating the lift stop assistance mode.

[0050] The operator control provides an operator lifting signal which may be varied in the range 0-100%, where 0% is indicative of no speed at all, and 100% is indicative of maximum speed.

[0051] When the operator control provides a signal greater than 0%, the controller is arranged to initially operate the lifting forks in the manually controlled lifting mode.

[0052] If the operator control provides a lifting signal greater than a threshold value, and the lifting signal is subsequently reduced to a level lower than said threshold value, the lift stop assistance mode is preferably activated. Most preferably, the lift stop assistance mode is activated upon fulfillment of two criteria simultaneously: that the lifting signal is beneath the threshold value and that the current fork height is within a window allowing lift stop assistance. As soon as any of these criteria fails to be fulfilled, the lift stop assistance mode is not activated, if the current mode is the manually controlled lifting mode, or is aborted, if the current mode is the lift stop assistance mode. In the lift stop assistance mode, the lifting signal provided to the lift motor is automatically reduced, so that the lifting of the lifting forks stops at a height corresponding to the next pre-stored shelf height.

[0053] The threshold value at which the lift stop assistance mode is activated is preferably in the range 50-90% of a maximum lifting signal, and preferably in the range 65-85%. Preferably, the threshold value is set to 70, 75 or 80%. The lift stop assistance mode is only activated when the operator control is first used to generate a high speed signal exceeding the threshold value, such as full speed, and then subsequently lowered beneath said threshold value.

[0054] The lift stop assistance mode can preferably be deactivated. For example, if it is determined that the lifting signal from the operator control has again been raised to a level exceeding said threshold level, the manually controlled lifting mode will preferably be re-entered. Thus, even though the lift stop assistance mode has been activated, the operator may still return to the manually controlled lifting mode by again operating the operator control to generate a lifting signal exceeding the threshold level. Further, if it is determined that the lifting signal from said operator control has been lowered to zero, the manually controlled lifting mode will also be re-entered.

[0055] In the lift stop assistance mode, the lifting signal is preferably first reduced to a first reduced level, and, at a certain distance from the next pre-stored shelf height, is further reduced to a second reduced level. The first reduced level may e.g. correspond to a level within the range 40-60% of the maximum lifting signal, and preferably such as 50%. The second reduced level may e.g. correspond to a level within the range 20-30% of the maximum lifting signal, such as 25%. Preferably, the first re-

duced level is initiated at a distance within the range of 20-1000 mm from the next pre-stored shelf height, such as at a distance of 700 mm. Preferably, the distance at which the first reduced level is initiated corresponds to the distance where the first window starts. Further, the first window preferably extends up to the next pre-stored shelf height. The second reduced level is preferably initiated at a distance within the range 5-100 mm from the next pre-stored shelf height, such as at a distance of 30 mm.

[0056] The automatically controlled reduced speed levels may be used instead of the actual speed level provided by the operator control. However, preferably, the automatically controlled reduced speed levels are used as a maximum value for the speed signal, whereby the real speed signal will be the lowest of the actual speed signal received from the operator control and the automatically activated reduced speed signal.

[0057] An alarm signal may be produced upon entry of the lift stop assistance mode. This alarm signal may e.g. be used to issue a notification on a display 27, informing the operator of the fact that the lift stop assistance mode has been activated. This message may either be in writing, or by flashing of the display, or a combination of the two. Also, the alarm signal may be used to generate a sound through a horn 28 or the like. The alarm signal may e.g. be one or several beeps or the like.

[0058] The display 27 may also be used to display information related to at least one of: the working mode of the controller, the present height of the forks, the height of the next pre-stored shelf height and the level number of the next pre-stored shelf height. Most preferably, several or all of these items of information are displayed.

[0059] The automatic control of the lifting movement is illustrated schematically in Fig. 3. Here, a set of forks are illustrated as being at a current height h. A shelf system comprises shelves at various heights, H1-H5, and these heights are pre-stored in the memory of the lifting control system. The pre-storing of the shelf heights may be provided by means of retrieving the height levels from a warehouse database, and store them in the memory on-board the truck. Alternatively, the heights may be determined and stored during an initialization and calibration process of the truck. Any number of shelf height levels may be used. However, preferably the pre-stored shelf heights are separated from each other by at least 50 cm, and preferably at least 60 cm.

[0060] In the situation illustrated in Fig. 3, and if the fork has been moved upwards at a speed exceeding the threshold, the next pre-stored height level will be height H4, and as soon as this level has been passed, the next pre-stored height level thereafter will be level H5. If the operator control is used to lower the lifting signal to a level below the threshold value at the current level h, and if the current level h is within the first window, the lift stop assistance mode will then be activated, and the forks will stop at height H4.

[0061] The intended next shelf level at which the forks are to be positioned generally differs between a situation when goods are to be stored/deposited, and when goods are to be retrieved/picked. The height difference between these positions can typically be a few centimeters, such as 5 cm.

[0062] The pre-stored shelf heights in the system may be either store levels, retrieve levels or both. In case only store levels or retrieve levels are stored, the system may automatically adjust these levels, e.g. by reducing the store level by a predetermined measure to receive a retrieve level, and vice versa. However, it is also possible to use only one level, e.g. a store level, whereby the user may manually slightly adjust the height of the forks after having stopped at the intended height to reach the other position.

[0063] However, in a preferred embodiment, the method further comprises the step of determining whether there is a load on the forks, and based on this determination, decide whether the next shelf height is a store level or retrieve level. Various ways are feasible for the system to determine whether there is a load on the forks, and thus, whether a store position or a retrieve position is desired. For example, this may be achieved by providing an additional operator control, such as a key, upon which the operator may select whether storing or retrieving is intended. Alternatively, a load sensor 24 may be used, which can sense whether there is any load on the forks, and if so selecting a storage height, or if there is no load, and if so selecting a retrieval height. The load sensor can e.g. be a weight sensor, an optical sensor, or the like.

[0064] According to another preferred embodiment, the method comprises the additional step of maintaining the lift stop assistance mode even after the stopping of the lifting of said lifting forks at the height corresponding to the next pre-stored shelf height, said level being a store level or retrieve level, and upon a further activation of the operator control automatically proceed with the lifting action to the corresponding retrieve level or store level, respectively. For example, the pre-stored shelf heights may be retrieve levels. After first having stopped at this level, the operator may gently operate the operator control, whereby the forks will proceed to the store level.

[0065] The further activation of the operator control can e.g. be to provide a lifting signal in the direction of the corresponding level. Preferably, the further action of the operator control provides a lifting signal lower than the above-discussed threshold level, or lower than another predetermined threshold level (which is then preferably lower than the first discussed threshold level).

[0066] Preferably, the lift stop assistance mode is maintained when two criteria are satisfied: that the lifting signal is still below a threshold value (the same threshold value as before, or a different threshold value) and that the current lift height of the forks is within a second window.

[0067] As before, the lift stop assistance mode can, also in this situation, preferably be aborted, and the man-

ually controlled lifting mode re-entered, e.g. by providing a lifting signal exceeding the threshold level. Further, the manually controlled lifting mode will preferably be re-entered if the operator control is operated to proceed with the lifting after the second stop.

[0068] As will be readily acknowledged by anyone skilled in the art, the controller and the software in the controller may be arranged in many different ways to determine the working mode in which it should operate. An example of a control loop to be executed by the controller to determine which working mode to use is illustrated in Fig. 4. Hereby, after initiation of a lifting action, the controller determines, in a first step, whether the lifting signal received from the operator control is below a threshold value. If no, the manually controlled lifting mode is used. If yes, it is then determined, in a second step, whether the current fork height is within a first window. If yes, the lift stop assistance mode is used for stopping the forks at the next pre-stored shelf height, which in this example is a retrieve height. If no, it is then determined, in a third step, whether the current fork height is within a second window. If no, the manually controlled lifting mode is used. If yes, the lift stop assistance mode is used for stopping the forks at the corresponding store height. This loop is then repeated continuously as long as the lifting operation is maintained, and re-activated as soon as a new lifting operation is initiated.

[0069] The person skilled in the art realizes that the present invention is not limited to the preferred embodiments. For example the system may use pre-stored store height levels, pre-stored retrieve height levels, or a combination of the two. The system may also automatically adjust between any of these types of height levels. Further, the threshold level may be set any suitable level, and the automatic reduction to a halt in the lift stop assistance mode may follow various schemes, etc. Such and other obvious modifications must be considered to be within the scope of the present invention, as it is defined by the appended claims. It should be noted that the above-mentioned embodiments illustrate rather than limit the invention, and that those skilled in the art will be able to design many alternative embodiments without departing from the scope of the appended claims. In the claims, any reference signs placed between parentheses shall not be construed as limiting to the claim. The word "comprising" does not exclude the presence of other elements or steps than those listed in the claim. The word "a" or "an" preceding an element does not exclude the presence of a plurality of such elements. Further, a single unit may perform the functions of several means recited in the claims.

Claims

1. A method for controlling a fork lift truck, comprising the steps of:

providing at plurality of pre-stored shelf heights;
receiving a lifting signal from an operator control for lifting forks of the industrial truck, thereby entering a manually controlled lifting mode;
determining that a condition for a lift stop assistance mode has been fulfilled, thereby entering the lift stop assistance mode;
automatically reducing, in said lift stop assistance mode, the lifting signal from said operator control so that the lifting of said lifting forks stops at a height corresponding to the next pre-stored shelf height.

2. The method of claim 1, further comprising the step of issuing an alarm signal upon entry of the lift stop assistance mode.

3. The method of claim 1 or 2, wherein the step of determining that a condition for the lift stop assistance mode has been fulfilled comprises determination that a manually operated switch is in an activated state.

4. The method of any one of the preceding claims, wherein the step of determining that the condition for the lift stop assistance mode has been fulfilled comprises determination that the lifting signal has been reduced to a level lower than a threshold value.

5. The method of claim 4, wherein the threshold value is in the range 50-90% of a maximum lifting signal, and preferably in the range 65-85% of said maximum lifting signal.

6. The method of any one of the preceding claims, further comprising the step of determining, when in said lift stop assistance mode, that the lifting signal from said operator control has been raised to a level exceeding said threshold level, and thereby re-entering said manually controlled lifting mode.

7. The method of any one of the preceding claims, further comprising the step of determining, when in said lift stop assistance mode, that the lifting signal from said operator control has been lowered to zero, and thereby re-entering said manually controlled lifting mode.

8. The method of any one of the preceding claims, wherein in the lift stop assistance mode, the lifting signal is reduced to a level being the lowest of a reduced maximum lifting level and the actual lifting signal provided by the operator control.

9. The method of any one of the preceding claims, wherein in the lift stop assistance mode, the lifting signal is first reduced to a first reduced maximum level, and, at a certain distance from the next pre-

stored shelf height, is further reduced to a second reduced maximum level.

10. The method of any one of the preceding claims, further comprising the step of determining whether there is a load on the forks, and based on this determination, decide whether the next shelf height is a store level or retrieve level.

11. The method of any one of the preceding claims, further comprising the step of maintaining the lift stop assistance mode even after the stopping of the lifting of said lifting forks at the height corresponding to the next pre-stored shelf height, said level being a store level or retrieve level, and upon a further activation of the operator control automatically proceed with the lifting action to the corresponding retrieve level or store level, respectively.

12. A fork lift truck comprising:

a mast carrying forks which can be moved in height between a lowered position and desired raised positions;
an operator control to be manually operated to move said forks;
a fork height sensor; and
a lift controller system comprising:

a memory including a plurality of pre-stored shelf heights;
a controller arranged to receive a lifting signal from the operator control for lifting forks of the industrial truck, thereby entering a manually controlled lifting mode, to determine that a condition for a lift stop assistance mode has been fulfilled, thereby entering a lift stop assistance mode, and to automatically reduce, in said lift stop assistance mode, the lifting signal from said operator control so that the lifting of said lifting forks stops at a height corresponding to the next pre-stored shelf height.

13. The fork lift truck of claim 12, further comprising an alarm signaling unit arranged to issue an alarm upon entry of the lift stop assistance mode.

14. The fork lift truck of claim 12 or 13, further comprising a load sensor for determining whether there is a load on the forks, wherein the controller is arranged to adjust, based on this determination, the next shelf height to be a store level or retrieve level.

15. The fork lift truck of any one of the claims 12-14, further comprising a display, said display being arranged to display information related to at least one of: the working mode of the controller, the present height of the forks, the height of the next pre-stored shelf height and the level number of the next pre-stored shelf height.

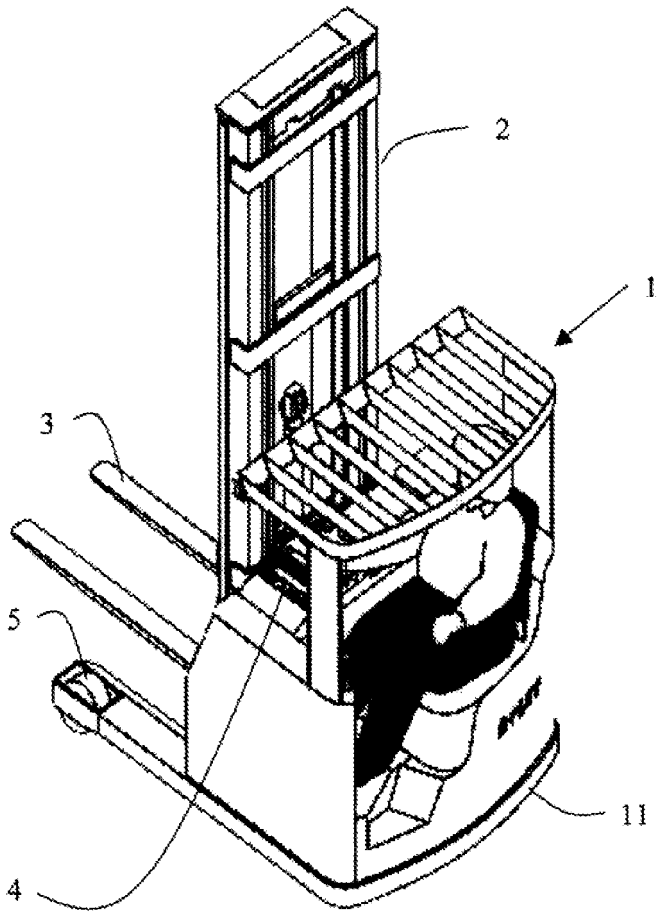
2
1
3
5
11
4

Fig. 1

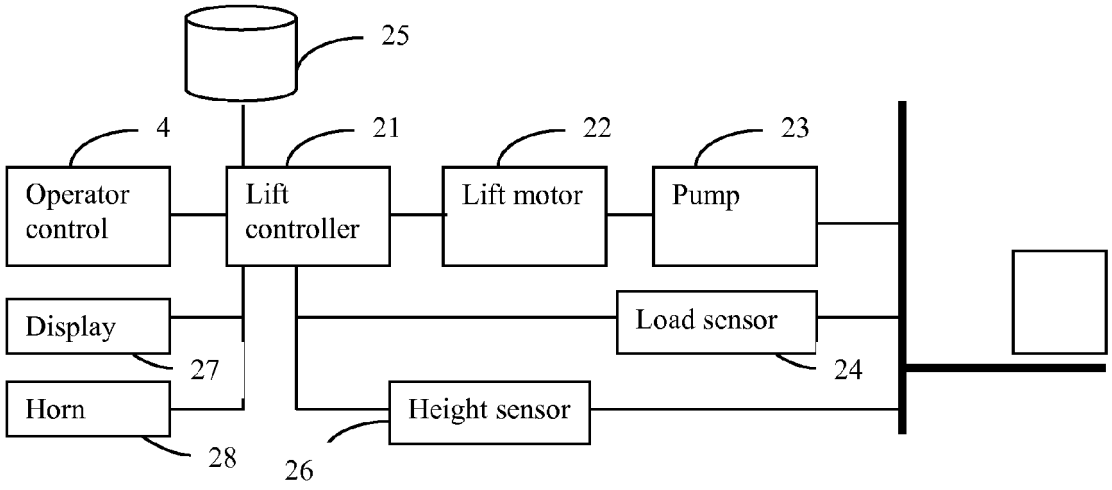
25
4
21
22
23
Operator control
Lift controller
Lift motor
Pump
Display
Load sensor
27
24
Horn
Height sensor
28
26

Fig. 2

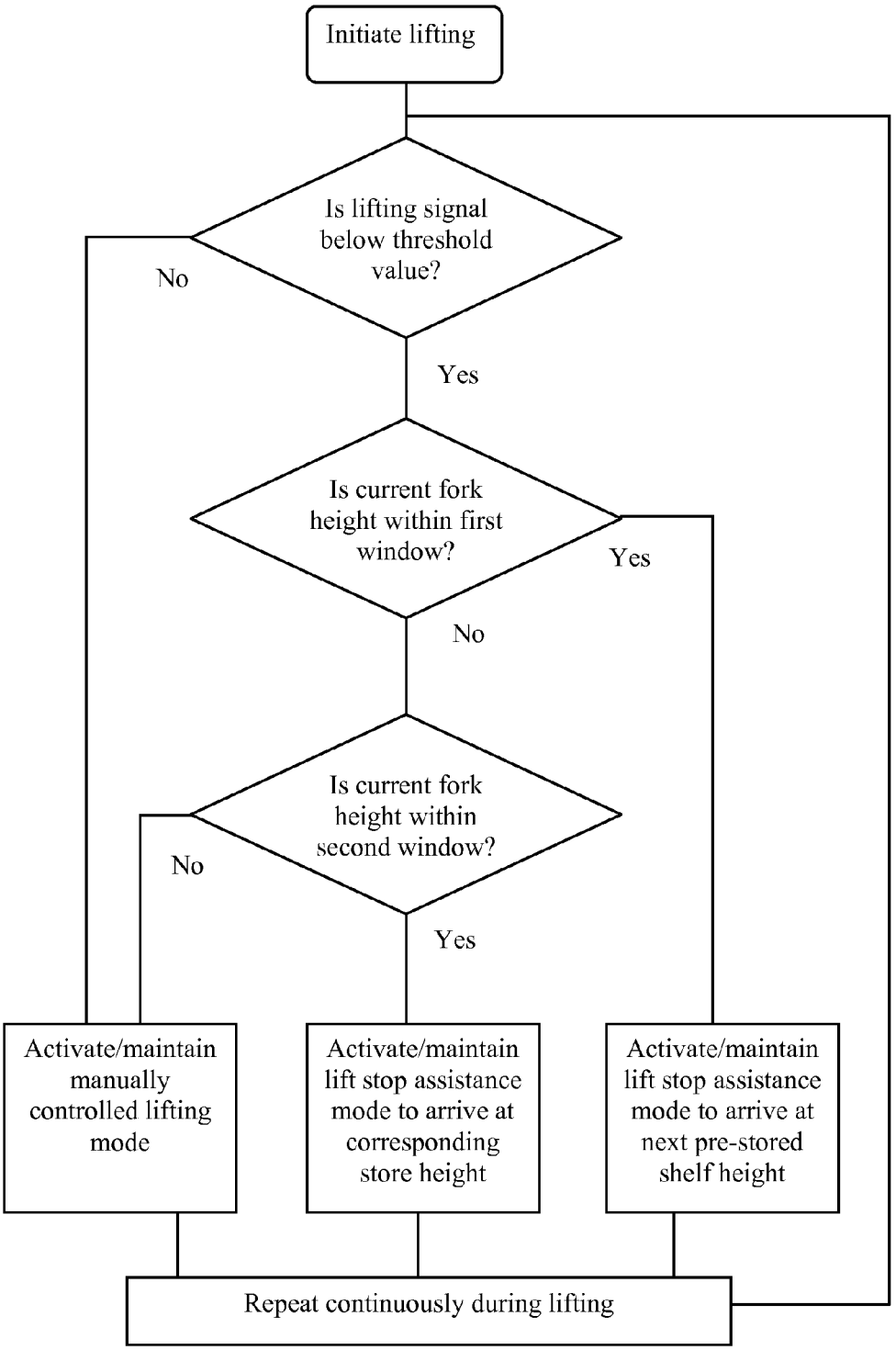
Initiate lifting
Is lifting signal below threshold value?
No
Yes
Is current fork height within first window?
Yes
No
Is current fork height within second window?
No
Yes
Activate/maintain manually controlled lifting mode
Activate/maintain lift stop assistance mode to arrive at corresponding store height
Activate/maintain lift stop assistance mode to arrive at next pre-stored shelf height
Repeat continuously during lifting

Fig 4

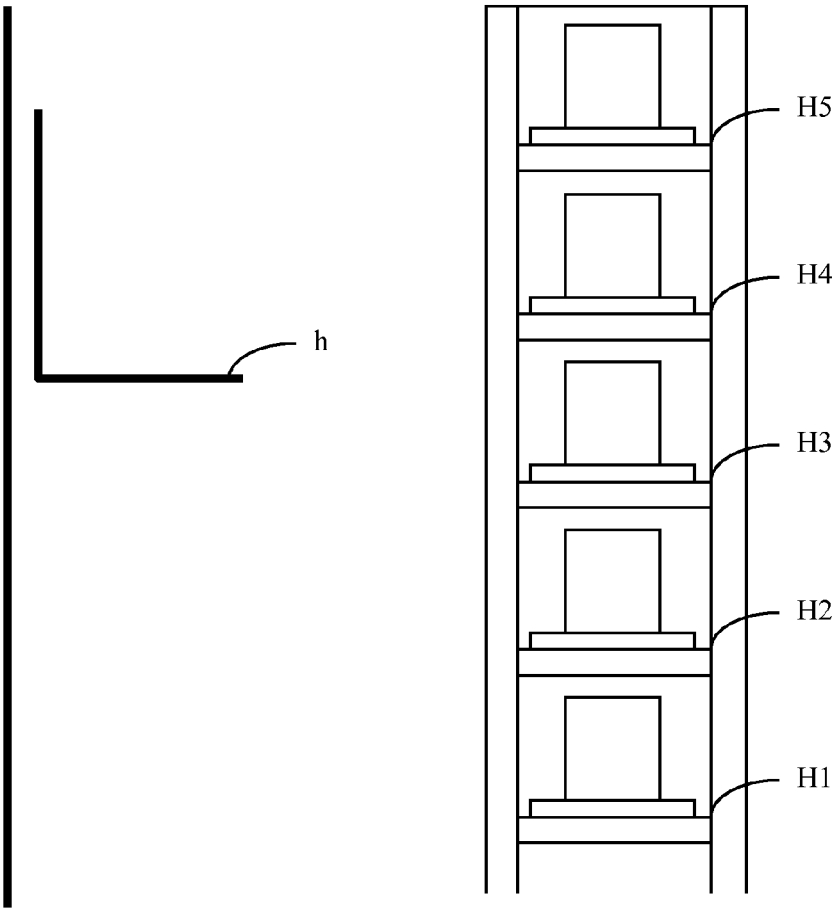

Fig 3

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 11 16 7826

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	US 4 547 844 A (ADAMS WALTER P [US]) 15 October 1985 (1985-10-15) * the whole document * -----	1-15	INV. B66F9/20
A	DE 21 51 334 A1 (IRION & VOSSELER) 2 November 1972 (1972-11-02) * the whole document * -----	1-15	

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	24 October 2011	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

1

EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 11 16 7826

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

24-10-2011

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 4547844 A	15-10-1985	NONE	
DE 2151334 A1	02-11-1972	DE 2114617 A1	28-09-1972

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 5011358 A **[0005] [0045]**
- US 5995001 A **[0005] [0045]**
- US 6533076 B **[0005] [0045]**
- US 7266904 B **[0005] [0045]**
- US 7219769 B **[0006]**
- US 4547884 A **[0006]**