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

(11) **EP 2 008 961 A1**

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
31.12.2008 Bulletin 2009/01

(51) Int Cl.:
B66F 9/20 *(2006.01)* ***B66F 9/24*** *(2006.01)*

(21) Application number: **07111422.7**

(22) Date of filing: **29.06.2007**

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HU IE IS IT LI LT LU LV MC MT NL PL PT RO SE SI SK TR
Designated Extension States:
AL BA HR MK RS

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(54) Control unit, method and computer program product for controlling a lift mechanism

(57) A control unit (20) for controlling a lift mechanism of an industrial truck arranged to receive an indication from an operator of the industrial truck, wherein the control unit (20) is further arranged to analyse the indication and to determine one of at least two modes of operation of the industrial truck based on the indication, wherein the at least two modes are a first normal mode and a second slow mode, arranged to run the lift mechanism at two different velocities, and the control unit is arranged to generate and transmit a control command indicating the determined mode.

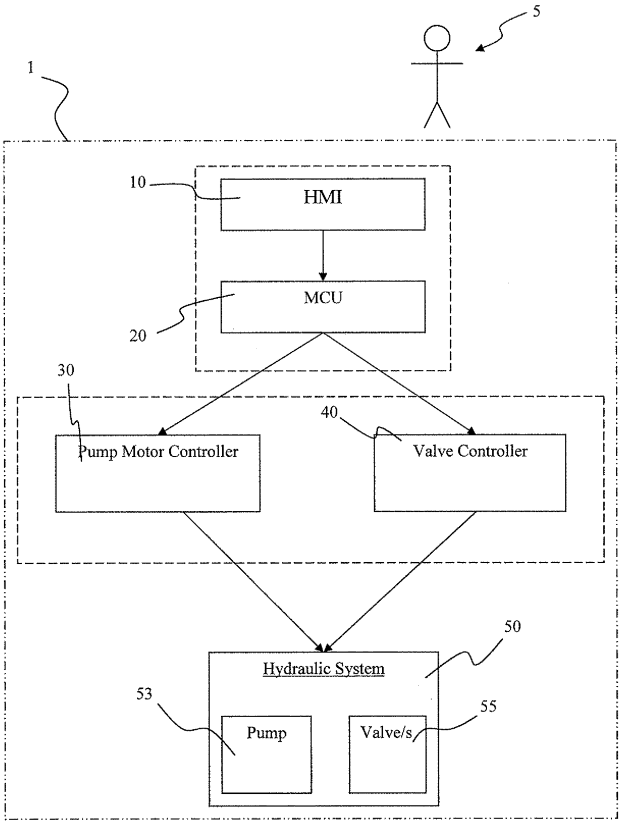

FIG. 1

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Description

TECHNICAL FIELD

[0001] The invention relates to a method, computer program product and a system for operating a lift mechanism. Specifically, the invention relates to control the velocity of the lift mechanism.

BACKGROUND ART

[0002] In the area of industrial trucks the aim to facilitate the manoeuvring of the trucks has resulted in a lot of different functions of the trucks. Today, the trucks are in general manually manoeuvred in travel speed as well as in controlling the lift mechanism using analogue controls that enables the operator to adjust the speed of the different mechanisms. When depositing/retrieving pallets the lift mechanism of a truck is manoeuvred using the analogues control, for example, using full throttle when moving an unloaded fork lift between a lowest position to a position in proximity of a retrieving position, that is, the position where to position the forks in under the pallet and lift it up. When the fork lift is in proximity of the wanted position the controls are manoeuvred gently up/down to position the fork in the accurate position. However, the analogue controls are expensive to implement into the trucks and are rather sensitive and have a tendency to break down.

[0003] It is an object of the invention to provide a control function of a lift mechanism that is cost efficient to implement into a truck.

SUMMARY OF THE INVENTION

[0004] The invention relates to a control unit, a computer program product and a method for controlling a lift mechanism according to claims 1, 17 and 12.

[0005] The invention relates to a control unit for controlling a lift mechanism of an industrial truck arranged to receive an indication from an operator of the industrial truck, wherein the control unit is further arranged to analyse the indication and to determine one of at least two modes of operation of the industrial truck based on the indication, wherein the at least two modes are a first normal mode and a second slow mode, arranged to run the lift mechanism at two different velocities, and the control unit is arranged to generate and transmit a control command indicating the determined mode.

[0006] In an embodiment a control unit is arranged to determine a mode of operation when the indication is a double click operation of an input element of the industrial truck.

[0007] In addition may the control unit be arranged to detect that the digital on/off input element has been double clicked by determining that a time interval between the release of the digital on/off input element and the reactivation of the digital on/off input element is within a predetermined time interval.

[0008] Furthermore, the invention discloses a control system for controlling a lift mechanism of an industrial truck comprising a digital on/off input element of a human-machine-interface , a main control unit according to what is stated above, and a lift mechanism control unit wherein the digital on/off input element is arranged to generate and send an operator signal to the main control unit when activated and the main control unit is arranged to receive the operator signal from the digital on/off input element and in response to the operator signal generate and transmit a control command to the lift mechanism control unit the lift mechanism control unit is arranged to receive the control command and based on the control command send out a control signal to the lift mechanism controlling the lift mechanism, wherein a lowering/lifting/laterally moving operation of the lift mechanism is run in first normal mode or a second slow mode based on the operator signal.

[0009] An embodiment of the control system discloses that the operator signal indicating the second slow mode is generated when the digital on/off input element is double clicked.

[0010] The operator signal indicating the first normal mode may be generated when the digital on/off input element is double clicked.

[0011] In an alternative embodiment the operator signal indicating a slow mode may be generated when the digital on/off input element, which is a separate slow input element, is activated.

[0012] In addition may the lift mechanism control unit of the control system be generating a power feed at a first power level at the first normal mode and a second lower power level at the second slow mode.

[0013] In the control system may the lift mechanism control unit be embodied as a pump motor controller unit and/or a valve control unit.

[0014] The invention further discloses an industrial truck comprising a lift mechanism and a control system in accordance with a control system disclosed above.

[0015] In an embodiment the industrial truck comprises a lift mechanism comprising a pump motor and a valve controlled by the lift mechanism control unit.

[0016] The invention further relates to a method for controlling a lift mechanism of an industrial truck, wherein the velocity of the lift mechanism can be run in a first normal mode or a second slow mode comprising the steps of; indicating that the lift mechanism should be run in the second slow mode by using a digital on/off input element of a human machine interface of the industrial truck, controlling an output of a lift mechanism control unit of the lift mechanism using a control command of a main control unit, said control command being based on the indication received from the human machine interface, and running the lift mechanism using the output from the lift mechanism control unit, thereby running the lift mechanism at a slow predetermined velocity.

[0017] Additionally may the indication of running the

lift mechanism in a second slow mode be a double click operation of the digital on/off input element.

[0018] The indication of running the lift mechanism in a second slow mode may in an embodiment be a single click action of the digital on/off input element indicating a slow mode.

[0019] The method may further comprise a step of indicating the first normal mode by double clicking the input element.

[0020] In an embodiment the lift mechanism control unit controls a pump motor, a valve, or a combination thereof.

[0021] The invention further relates to a computer program product for controlling a lift mechanism of an industrial truck, wherein the lift mechanism can be run in a first normal mode at a first velocity or a second slow mode at a second slower velocity based on an indication from an operator, said computer program product is arranged, when executed on a main control unit according to what is stated above, to execute a method comprising the steps of: receiving a signal from the digital on/off input element operated by the operator; determining what mode is indicated based on the signal from the digital on/off input element, transmitting a command signal indicating determined mode to the lift mechanism control unit of the control system.

[0022] The invention provides a control for a lift mechanism that is cost efficient as well as facilitates the operation of the lift mechanism.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023] The invention, together with further objectives and advantages thereof, may best be understood by reference to the following description taken in conjunction with the accompanying drawings in which:

Figure 1 shows a schematic overview of components of an industrial truck;
Figure 2 shows an embodiment of a human machine interface;
Figure 3 shows a diagram of how the lift speed varies under an operation of an industrial truck comprising an embodiment of the invention;
Figure 4 shows a schematic block diagram

DETAILED DESCRIPTION

[0024] In figure 1 a schematic overview of an embodiment of an industrial truck is shown. In the embodiment the truck comprises a digital on/off input element of a human machine interface (HMI) 10 which is operated by an operator 5 of the truck. The interface may be an operator panel or the like (see figure 2). The truck further comprises a main control unit 20, such as a CPU or the like, arranged to receive an operator signal from the HMI 10 and to send a control command to a lift mechanism control unit 30,40, which is controlling a lift mechanism component 53, 55, for example by feeding an electrical current to the lift mechanism. In the illustrated embodiment the lift mechanism is a hydraulic system, however, any type of lift mechanism may be used, such as electromechanical, pneumatic or the like. The lift components of the system may be an electric motor running a pump of a hydraulic system, a valve controlling the lowering (or lifting) of the lift mechanism or the like.

[0025] In order to operate the lift mechanism in a flexible manner, such as slowing down the lift when lowering fragile loads or similar, a function is implemented into the control system of the industrial truck. The function enables the operator to indicate and set the operation of the lift mechanism in a normal mode and a slow mode. That is, the main control unit detects that the operator has indicated a mode change and sends a control message over a network, such as a CAN-network, to the lift mechanism control unit indicating that the lift mechanism control unit should be set in, for example, the slow mode resulting in that the lift mechanism control unit is feeding a lower power to lift mechanism components slowing down the lifting /lowering/laterally movement of the lift to a predetermined velocity level lower than the velocity level of the normal mode.

[0026] As an example of operation, the operator indicates that the lift mechanism of the truck should be run in a slow mode. In an embodiment of the invention this is indicated by double clicking the digital indicator of the HMI 10. In an alternative embodiment this may be indicated by pressing a turtle button, that is, a button that indicates when a truck should be run in a slow mode. In the illustrated example, the double click function is used, which is a function that is cost efficient and easy to use/implement by merely implementing program code into the main control unit. It should be noted that the input element may be pressed in any different pattern/way indicating a slow mode.

[0027] It should also be noted that the operator may indicate that the lift mechanism should be run in a normal mode by double clicking the input element and in a slow mode by merely clicking the input element once.

[0028] In an example of performing a slow lifting operation of the hydraulic lift mechanism, the operator 5 of the industrial truck indicates a slow mode lifting operation, for example, by double clicking an input element. The input element of the interface 10 sends a signal to the main control unit 20 each time it is pressed down. The indication of slow mode operation is detected by the main control unit 20, that is, the main control unit 20 detects that a double click operation has been performed by using a timer function in the main control unit. For example, the main control unit 20 detects that the digital input element is pressed down indicating that the lift mechanism should be raised in a normal mode. As long as the digital input element is pressed down the lift is raised at a normal velocity, that is, a hydraulic pump of the hydraulic system is running at its normal rotation speed and without any valve affecting the flow to the lift

cylinder. However, when the digital input element is released and quickly depressed (quickly may be interpreted as a time limit of a suitable predetermined time such as within one second or the like), the main control unit 20 detects that a double click operation has been performed, that is, the main control unit 20 measures/detects/determines the time interval between the release of the digital input element and when the digital input element is pressed down again and compares to a predetermined interval. The time interval set to detect a double click may be set at the manufacturing of an industrial truck as well as adjustable by the operator.

[0029] It should here be noted that any way of detecting a double click may be implemented into the control system.

[0030] The main control unit 20 may be separated from the human machine interface 10 just as it may be a part of a same unit as indicated by the dashed lines.

[0031] Then the main control unit 20 sends a control command to the lift mechanism control unit, in the example a pump motor controller unit 30, indicating for example, a predetermined percentage of the normal speed that should be used as the operator has indicated that the slow mode should be used.

[0032] When the pump motor controller unit 30 receives the control command, such as a packet/message indicating over a CAN network, indicating a slow mode (for example, a percentage of the normal speed) the pump motor controller unit 30 feeds a pump motor 53 of the hydraulic system 50 with a predetermined power at a level generating a low rotation speed (the indicated percentage) of the pump motor 53. The low rotation speed is lower than upper rotation speed of the normal mode.

[0033] It should be understood that the level of power generating normal/slow velocity may be pre set at the manufacturing of the industrial truck or adjustable by the operator under settings of the control program or the like.

[0034] It should be noted that the slow lift mode can also be realized through by controlling valves affecting the pump flow, such as a valve which opens to lead a part of the pump flow to a reservoir instead of to the lift cylinder. This valve can be a dedicated valve or a valve also used to control the lowering movement. The lift mechanism control unit 30, 40 would in this case receive a command/s to open up the dedicated valve/or lowering valve to a certain level or any combination of a reduced speed of the pump motor and an amount of open valve.

[0035] In the case of a lowering operation the main control unit 20 sends a control command to a valve control unit 40 that slow mode of the lift mechanism is indicated and the valve control unit 40 sends a signal opening a valve 55 of the hydraulic system 50 a predetermined amount in order to lower the lift mechanism in slow mode. The signal may be a current or the like based on the type of valve used.

[0036] It should be noted that the pump motor controller unit 30 and the valve control unit 40 may be separate units or a one piece unit as indicated by the dashed lines.

[0037] In an embodiment wherein the lifting and lowering of the lift mechanism is controlled by controlling solely a valve/s the control command may be generated at a traction motor control unit or a main control unit.

[0038] In figure 2, a schematic overview of a human machine interface (HMI) 10 is shown. In the illustrated example the HMI 10 comprises a lifting input element 12 and lowering input element 14. In an embodiment an operator of the HMI 10 indicates a slow mode of the lift mechanism by double clicking the lifting input element 12 or the lowering input element 14. In an alternative embodiment the slow mode may be indicated by pressing a separate slow button setting the lift mechanism in a slow mode (illustrated as a dashed line button 19) as well as a motor driving a traction wheel on the ground. The HMI 10 further comprises two steering handle grips 15, 16 to facilitate the steering of the truck when operating the truck. It should be noted that in an embodiment of the HMI 10 a visual indication arranged on the human machine interface that the lift mechanism is set in a slow mode is used to visually indicate to the operator the mode of the lift mechanism, such as illumination of input elements in a certain colour, a symbol of a display is activated or the like.

[0039] In figure 3, a schematic diagram of an operation of a control system is shown. The lift mechanism is initially run in a normal lift mode, for example, by pressing and holding down the lifting input element 12 of figure 2. This results in that the lift mechanism is raised at a preset maximum velocity v(liftmax). Then, when the operator releases the lifting input element 12 and depresses the lifting input element 12 the lift velocity of the lift mechanism is lowered to a predetermined lower level v(liftslow). It should be noted that the velocity will not drop instantaneously but rather as indicated by the dashed line. The operator then releases the lifting input element 12 and presses the lowering input element 14 resulting in that the velocity of the lowering operation is, as this is a first time lowering click, set to the maximum lower velocity v (lowmax), the input element 14 is then quickly released and depressed resulting in a lower lowering velocity v (lowslow). Finally the lowering input element is released and the lift mechanism stops.

[0040] In figure 4, a schematic block diagram of a method of operating a lift mechanism into a slow mode is shown.

[0041] In step 82, an operator of an industrial truck, such as a pallet stacker, order picker truck or the like, indicates by, for example, double clicking an input element, such as the lowering input element 14 in figure 2, that the lift mechanism should be run in a slow mode. This may be the case, as stated above, when a pallet loaded with fragile material is carried by the forks or like of the lift mechanism and is to be set down onto the ground or the like.

[0042] In step 83, a main control unit detects that a double click has been performed by receiving a signal

set to "one" from the digital on/off input element followed by a "zero" (no signal) and again a signal set to "one" within a predetermined time set in logic arranged in the main control unit. It should here be understood that the signal scheme may be arranged the other way around, that is, generating a logic true signal (a "one" signal) when the input element is not activated and a logic false signal (a "zero" signal) when the input element is activated.

[0043] In step 84, the main control unit sends a control command to a mechanism lift mechanism control unit indicating a certain output from a mechanism lift mechanism control unit. In the case of lowering the lift in a hydraulic lift mechanism in a slow mode, the main control unit sends a message to a valve control unit that the lowering mechanism should be set to a slow mode. If the operator would want to perform a lifting operation the message would be sent to a pump motor controller unit or a valve control unit as stated above.

[0044] In step 85, the lift mechanism control unit receives the control command and thereby changes its settings of its output to the lift mechanism. In the example the valve control unit may receive a command that indicates a 50 percent opening of the valve.

[0045] In step 86, the lift mechanism control unit controls the lift mechanism by sending a main control signal to the lift mechanism. In the described example of lowering the lift mechanism in a slow mode the valve control unit may transmit a current to a proportional valve opening the proportional valve a smaller distance than in the normal mode.

[0046] In an embodiment the lift mechanism control unit is a variable speed unit and changes between the normal mode and the slow mode by ramping.

[0047] In step 87, the lift mechanism will run based on the output of the lift mechanism control unit-. For example, the fluid from a lift cylinder is slowly let through the proportional valve and the lift will descend slowly.

[0048] It should be understood that a computer program is installed in the main control unit realising the slow mode function.

[0049] It should also be understood that the number of modes may be increased, such as a third middle mode and so on.

[0050] Generally a lift mechanism moves in a vertical direction. However, it should be understood that the lift mechanism may also move in a horizontal direction and the slow mode function according to the present invention may in an embodiment be implemented moving the lift mechanism in the horizontal direction. In this embodiment the movement of the lift mechanism is controlled by a double acting hydraulic cylinder.

[0051] The foregoing has described the principles, preferred embodiments and modes of operation of the present invention. However, the invention should be regarded as illustrative rather than restrictive, and not as being limited to the particular embodiments discussed above. It should therefore be appreciated that variations may be made in those embodiments by those skilled in the art without departing from the scope of the present invention as defined by the following claims.

Claims

1. A control unit (20) for controlling a lift mechanism of an industrial truck arranged to receive an indication from an operator of the industrial truck, **characterised in that** the control unit (20) is further arranged to analyse the indication and to determine one of at least two modes of operation of the industrial truck based on the indication, wherein the at least two modes are a first normal mode and a second slow mode, arranged to run the lift mechanism at two different velocities, and the control unit is arranged to generate and transmit a control command indicating the determined mode.

2. A control unit (20) according to claim 1, which is arranged to determine a mode of operation when the indication is a double click operation of an input element of the industrial truck.

3. A control unit (20) according to the claim 2, wherein the control unit is arranged to detect that a digital on/off input element of an human machine interface of the industrial truck has been double clicked by determining that a time interval between the release of the digital on/off input element (10) and the reactivation of the digital on/off input element (10) is within a predetermined time interval.

4. A control system for controlling a lift mechanism of an industrial truck comprising a digital on/off input element of a human-machine-interface (10), a main control unit (20) according to any of claims 1-3, and a lift mechanism control unit (30,40) wherein the digital on/off input element is arranged to generate and send an operator signal to the main control unit (20) when activated and the main control unit (20) is arranged to receive the operator signal from the digital on/off input element and in response to the operator signal generate and transmit a control command to the lift mechanism control unit (30,40), the lift mechanism control unit (30,40) is arranged to receive the control command and based on the control command send out a control signal to the lift mechanism controlling the lift mechanism, wherein a lowering/lifting/laterally moving operation of the lift mechanism is run in first normal mode or a second slow mode based on the operator signal.

5. A control system according to claim 4, wherein the operator signal indicating the second slow mode is generated when the digital on/off input element is double clicked.

6. A control system according to claim 4, wherein the operator signal indicating the first normal mode is generated when the digital on/off input element is double clicked.

7. A control system according to any of claims 4, wherein the operator signal indicating a slow mode is generated when the digital on/off input element, which is a separate slow input element, is activated.

8. A control system according to any of the claims 4-7, wherein the lift mechanism control unit (30,40) is generating a power feed at a first power level at the first normal mode and a second lower power level at the second slow mode.

9. A control system according to any of claims 4-8, wherein the lift mechanism control unit is a pump motor controller unit (30) and/or a valve control unit (40).

10. An industrial truck comprising a lift mechanism (50) and a control system according to any of claims 4-9.

11. An industrial truck according to claim 10, wherein the lift mechanism comprises a pump motor (53) and a valve (55) controlled by the lift mechanism control unit.

12. A method for controlling a lift mechanism of an industrial truck, wherein the velocity of the lift mechanism can be run in a first normal mode or a second slow mode comprising the steps of;

- indicating that the lift mechanism should be run in the second slow mode by using a digital on/off input element of a human machine interface (10) of the industrial truck,
- controlling an output of a lift mechanism control unit (30,40) of the lift mechanism using a control command of a main control unit (20), said control command being based on the indication received from the human machine interface, and
- running the lift mechanism using the output from the lift mechanism control unit, thereby running the lift mechanism at a slow predetermined velocity.

13. A method according to claim 12, wherein indication of running the lift mechanism in a second slow mode is a double click operation of the digital on/off input element.

14. A method according to claim 12, wherein the indication of running the lift mechanism in a second slow mode is a single click action of the digital on/off input element indicating a slow mode.

15. A method according to claim 12, wherein the method further comprises a step of indicating the first normal mode by double clicking the input element.

16. A method according to any of claims 12-15, wherein the lift mechanism control unit (30, 40) controls a pump motor, a valve, or a combination thereof.

17. A computer program product for controlling a lift mechanism of an industrial truck, wherein the lift mechanism can be run in a first normal mode at a first velocity or a second slow mode at a second slower velocity based on an indication from an operator, said computer program product is arranged, when executed on a main control unit according to any of claims 1-3, to execute a method comprising the steps of:

- receiving a signal from the digital on/off input element (12,14) operated by the operator;
- determining what mode is indicated based on the signal from the digital on/off input element,
- transmitting a command signal indicating determined mode to the lift mechanism control unit of the control system.

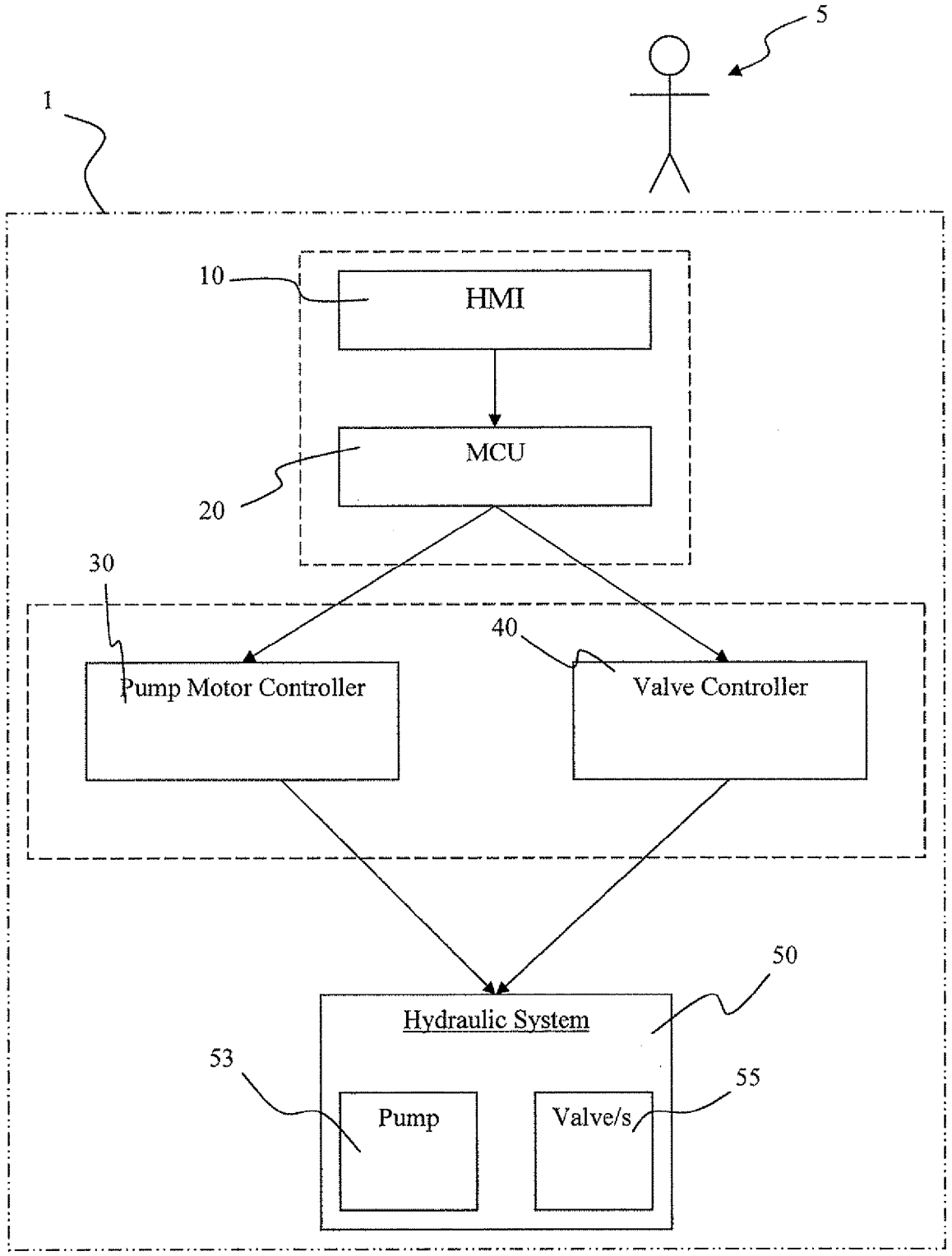
5
1
10
HMI
MCU
20
30
40
Pump Motor Controller
Valve Controller
50
Hydraulic System
53
55
Pump
Valve/s

FIG. 1

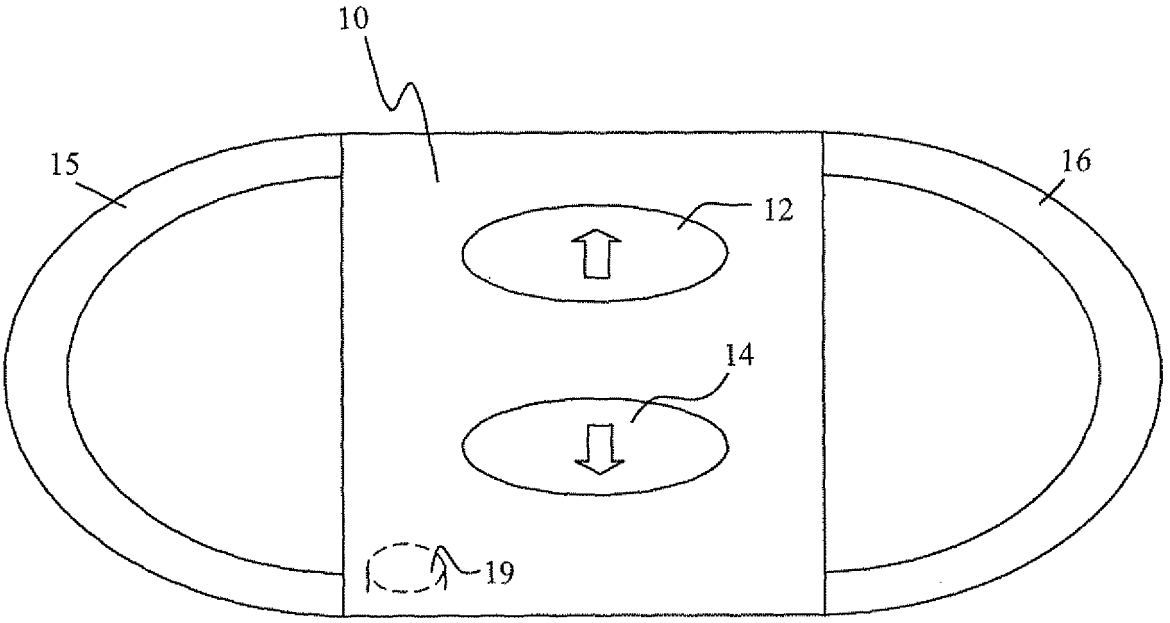
10
15
16
12
14
19

FIG. 2

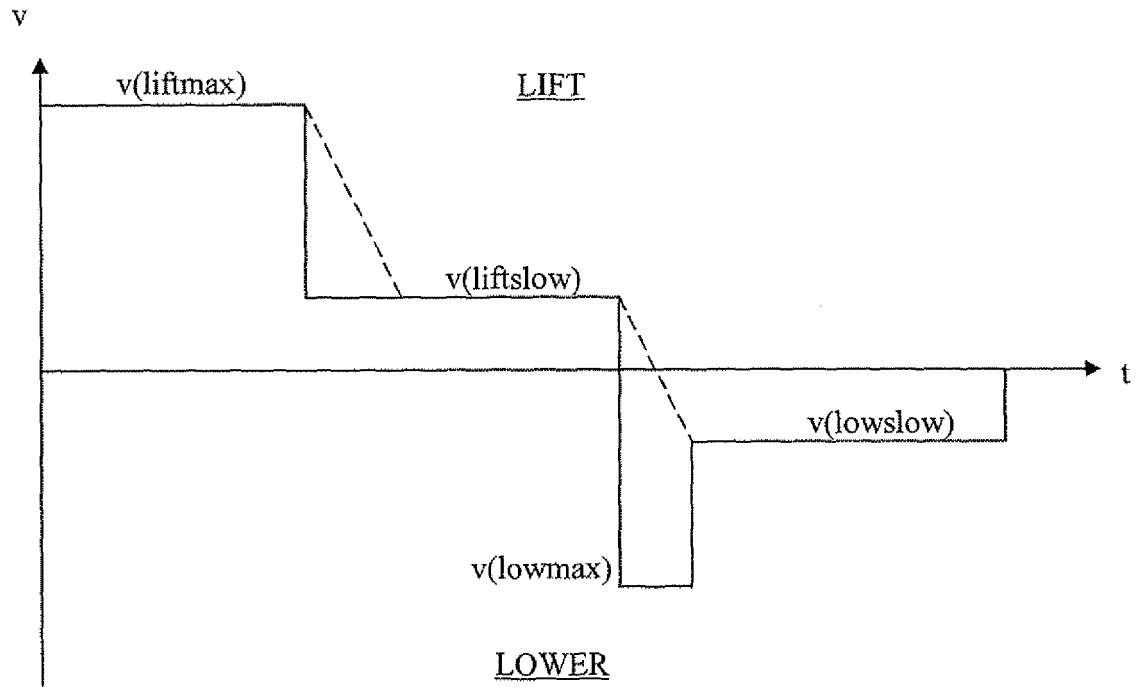
v
v(liftmax)
LIFT
v(liftslow)
t
v(lowslow)
v(lowmax)
LOWER

FIG. 3

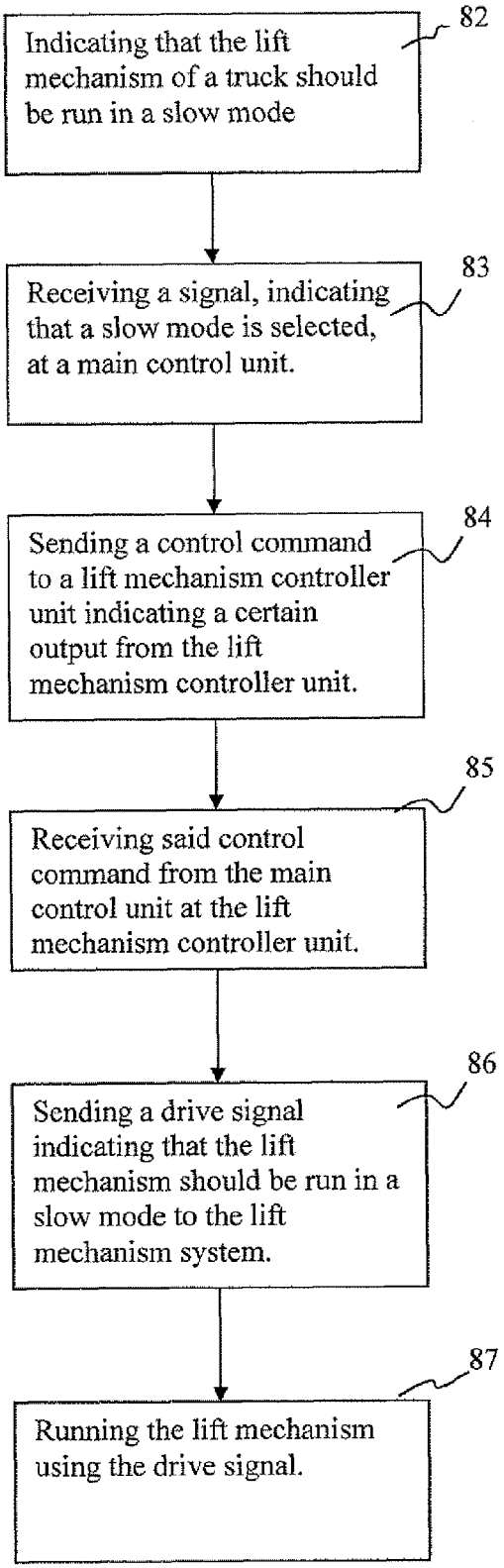
Indicating that the lift mechanism of a truck should be run in a slow mode
82
Receiving a signal, indicating that a slow mode is selected, at a main control unit.
83
Sending a control command to a lift mechanism controller unit indicating a certain output from the lift mechanism controller unit.
84
Receiving said control command from the main control unit at the lift mechanism controller unit.
85
Sending a drive signal indicating that the lift mechanism should be run in a slow mode to the lift mechanism system.
86
Running the lift mechanism using the drive signal.
87

FIG. 4

European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 11 1422

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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	11 December 2007	Verheul, Omiros

CATEGORY OF CITED DOCUMENTS

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