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(54) SAFETY DEVICE FOR A FORK LIFT TRUCK

SICHERHEITSVORRICHTUNG FÜR EINEN GABELSTAPLER

DISPOSITIF DE SECURITE POUR UN CHARIOT ELEVATEUR A FOURCHE

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Description

Technical Field

[0001] The present invention relates to a safety device for fork lift trucks and the like, for example counterbalanced fork lift trucks, retractable trucks, stackers, pilers, trucks with lift platform, etc.
In the following description specific reference is made to a safety device for counterbalanced fork lift trucks, without in any way limiting the scope of the inventive concept.

Background Art

[0002] A standard configuration of the latter has a chassis with two axles, one at the front and a steering axle at the rear.
The front axle normally has two wheels close to a lifting apparatus located at the front end of the chassis.
At the back, the truck may have a set of counterweights attached to the chassis and the rear steering axle which may have two transversally distanced wheels, similarly to the front axle. Alternatively, the rear axle may have two wheels set close together, also known as twin wheels, which turn about a shared vertical axis, or the rear axle may comprise a single rear wheel located at the longitudinal centre line of the truck and also turning relative to a vertical axis.
The lifting apparatus normally comprises a fork mobile up and down, using a vertical mast, driven by one or more hydraulic lifting pistons.
Fork lift trucks are often used for handling considerable weights which reduce truck stability due to the particular distribution of the weights created according to the contact surface defined by the wheels.
This reduced stability, also depending on the dynamic phenomena caused with the longitudinal and transversal accelerations to which the truck is subjected during use, may cause the truck or the weight supported by the fork to tip over.
Many devices have been studied with the aim of increasing the safety of fork lift trucks, in particular devices designed to reduce the risk of trucks tipping over.
Most of the known above-mentioned devices are designed to evaluate, moment by moment, the load situation with measurements on the front lifting apparatus.
However, these solutions do not give a real image of the stability of the entire truck, load and contact surface.
Safety devices have also been studied, such as that described in patent EP-0 465 838, in which the truck is equipped with a unit for fixing the rear axle which slides along a substantially vertical guide, so as to apply load factors to the distribution of the weights on the axles.
The fixing unit comprises a potentiometer attached to the lifting piston to detect the relative movement between the chassis and the rear axle fixing unit.
If the rear axle and the chassis move away from one another too far, triggering a potential forward tipping motion, the potentiometer interacts, by means of suitable interfaces, with the hydraulic lifting piston, to re-establish an equilibrium, substantially, on the position of the load.
Said device has some disadvantages due to the complex structure of the rear axle fixing unit, which requires a particular construction architecture involving considerable costs for the fork lift truck and frequent and constant adjustments.

Disclosure of the Invention

[0003] One aim of the present invention is to provide an improved safety device for fork lift trucks, which takes into account the distribution of the weights on the contact surface and is simple to implement and easy to attach substantially to any type of fork lift truck without extensive work on the truck structure.
[0004] In accordance with one aspect of it, the present invention proposes a safety device as specified in claim 1.
[0005] The dependent claims refer to preferred, advantageous embodiments of the invention.

Brief Description of the Drawings

[0006] Embodiments of the present invention are described below, without in any way limiting the scope of the inventive concept and with reference to the accompanying drawings, in which:

- Figure 1 is a schematic side view of a fork lift truck equipped with a safety device according to the present invention;
- Figure 1a is a view of a further detail of the fork lift truck safety device illustrated in Figure 1;
- Figure 2a is an enlarged schematic rear view of a detail of the device illustrated in Figure 1a;
- Figure 2b is an enlarged schematic rear view of a different embodiment of the same detail as illustrated in 2a;
- Figure 2c is a top plan view of the detail illustrated in Figure 2b;
- Figure 3 is a schematic block diagram relative to an operating strategy for the safety device according to the present invention;
- Figures 4a to 4e are flow charts illustrating the blocks in the diagram illustrated in Figure 3.

Detailed Description of the Preferred Embodiments of the Invention

[0007] In particular with reference to Figure 1, the numeral 1 denotes as a whole a safety or anti-tipping device for a fork lift truck 2.
[0008] The fork lift truck 2, of the substantially known type, therefore, with only the parts necessary for an understanding of the text described, comprises a chassis 3 supported by a front axle 4 and a rear axle 5 fitted with respective wheels 6 and 7 and a truck 2 driving position

2a.

[0009] The following description considers the general case of a four-wheeled truck 2 in which the front wheels 6 are non-steering and the rear wheel 7 are directional.

[0010] The truck 2 is equipped with a lifting apparatus 8 located at the front wheels 6 and substantially comprising a mast 9 which tilts relative to the chassis 3 (swinging movement). A slide 10 driven by a piston 11, which may for example be hydraulic, slides along the mast 9 from the bottom to the top and vice versa.

[0011] The slide 10 advantageously consists of a fork 10a set up to support and handle a load X illustrated in Figures 1 and 1a.

[0012] According to substantially known construction architectures, the truck 2 comprises a communication channel 12 (for example of the CAN-bus type) supporting most of the instructions and information relative to truck 2 operation, that is to say, the main operating parameters and commands set by a driver OP for the truck 2.

[0013] The device 1, as described below, interacts with truck 2 dynamics through the communication channel 12.

[0014] In particular with reference to Figure 1, it may be seen how the device 1 comprises means 31 for acquiring information about the load X lifted by the slide 10.

[0015] The acquisition means 31 comprise a detector 50 attached to the lifting apparatus 8.

[0016] In detail, the detector 50 has a weight sensor 51 for measuring a weight value P for the load X lifted by the slide 10.

[0017] The weight sensor 51 advantageously consists of a load cell of the known type and therefore not described in further detail.

[0018] In accordance with the preferred embodiment illustrated in Figure 1, the weight sensor 51 is attached to the piston 11 which is located at the mast 9. Alternatively, the weight sensor 51 may be attached directly to the slide 10.

[0019] The detector 50 also has a height sensor 52 for measuring a distance D from the base of the chassis 3 to the load X.

[0020] In further detail, the height sensor 52 consists of a transmitter element 53 which sends an ultrasound signal U and a receiver element 54 which picks up the signal U.

[0021] The transmitter element 53 is preferably attached to the fork 10a, whilst the receiver element 54 is located in a base portion 54a of the chassis 3 corresponding to the base on which the entire truck 2 rests.

[0022] The height sensor 52 also has a block 55 for processing the ultrasound signal U, the block 55 supplying a value representing the distance D according to the speed at which the signal U is issued (speed of sound) and the time taken for the signal U to be picked up.

[0023] In other words, the transmitter element 53 sends the signal U at a predetermined frequency, for example 40 kHz, for 1 ms every 100 ms. At the same time, the block 55 activates a counter which is stopped at the moment when the receiver element 54 picks up the signal U. The block 55 now contains a value which is the signal transfer time, which calculated according to the constant speed provides the distance value D representing the distance between the slide 10 and the base 54a of the chassis 3.

[0024] The device also has an analogue - digital converter 56 for converting the weight value P and height value D supplied by the sensors 51, 52 from analogue to digital values.

[0025] The acquisition means 31 described above are advantageously connected to a processing unit 18.

[0026] The processing unit 18 is advantageously connected to the converter 56 so that it receives the digital values, compares them with preset weight and height parameters and sends a signal S representing the truck 2 safety status.

[0027] In other words, with reference to the flow chart in Figure 1, the processing unit 18 detects whether or not the weight value P and distance are greater than the preset load and height safety values.

[0028] In particular, in the block 60 the weight value P is compared with a nominal load value. If said value P is greater than the nominal load, block 61 performs a comparison to check if the distance value D is greater than a nominal height value. If the distance value D is also greater than the height value, a signal S1 is sent to a block 70 representing a risk status for the load X lifted.

[0029] If the weight value P is less than the nominal load value, or if the weight value is greater than the nominal load value but the distance value D is less than the nominal height value, a further comparison is performed between reduced load and reduced height values and the weight value P and distance value D.

[0030] In practice, the reduced load value consists of a weight value which depends on the height (the load is reduced as the height increases), and similarly the reduced height value represents a distance value which depends on the load.

[0031] Therefore, block 62 compares the weight value P with the reduced load value. If the weight P is less than the load, the signal S representing the safe status for the load X lifted is sent. In contrast, if the weight value P is greater, block 63 performs a comparison to check if the distance value D is greater than the reduced height value. If the distance value D is less, then the signal S representing the safe status is sent, otherwise, if the value D is greater, a signal S2 representing a risk status for the load X lifted is sent.

[0032] The signals S, S1 and S2 are sent to a block 70 directly connected to safety means 30 operatively connected to the truck 2 so that they can act on it.

[0033] In particular, the safety means 30 have an indicator device 29 attached to the truck 2. When the safety means 30 receive the signal S representing the safe status for the load X lifted, the indicator device is not activated and the truck is allowed to operate freely.

[0034] If the safety means 30 receive signals S1 and S2 representing a risk status for the load X lifted, the indicator device is activated.

[0035] The indicator device 29 may consist of a visual warning device 29a and/or an acoustic alarm 29b, as described in more detail below.

[0036] Moreover, the safety means have a control part 57 for activating or deactivating the lifting apparatus 8 depending on the signal processed by the processing unit 18.

[0037] In other words, if the signals S1 and S2 dangerously exceed a predetermined safety threshold, the control part 57 deactivates the lifting apparatus 8 to prevent the risk of the truck tipping over. Alternatively or additionally, the acquisition means 31 may also have a load detector 13 integral with the rear axle 5 of the truck 2 (Figure la).

[0038] In more detail, in the embodiment illustrated in Figure 1a, the detector 13 comprises a bar 14, for example ferrous or made of a material with similar elastic properties, secured on the rear axle 5 so that it substantially becomes completely integral with it and precisely reproduces its deformations, as explained below.

[0039] At the ends of the bar 14 there are a pair of holes 14a with which it is fixed to the rear axle 5 using two bolts 14b.

[0040] The detector 13 also comprises a pair of Wheatstone strain gauge bridges 15, of the substantially known type, which are glued to the bar 14.

[0041] Advantageously, the device 1 has two bridges 15 to allow for any deterioration in their characteristics and to allow for any malfunctions in one of the two. The bridges 15 are installed in a redundant manner to guarantee service continuity.

[0042] It should be noticed that, as is known, each Wheatstone strain gauge bridge 15 comprises four strain gauges which may be of any substantially known type, for example, with semiconductor (or piezoresistive), glued conductor (or metal layer or plate), non-glued conductor (or wire strain gauge).

[0043] Operation of the bridge 15, substantially known, is based on the variation in resistance due to a change in the cross-section/length ratio of a conductor subjected to a stress and so deformed.

[0044] In alternative embodiments, the Wheatstone bridge or bridges 15 are substituted with one or more simple strain gauges 16 with the same functions as the bridge 15.

[0045] It should be noticed that the axle 5 normally comprises a substantially middle portion 5a and two half-parts 5b with pins 5c to which the wheels 7 are attached.

[0046] The truck 2 rests on the ground with its wheels 7 and is attached to the chassis 3 at the portion 5a.

[0047] In this way, the axle 5 is subject to a bending deformation due to the weight above it, at the portion 5a, and the reaction of the ground through the wheels 7. For this reason the axle 5 has a deformation characterised by lengthening of the lower fibres, facing the ground, and shortening of the upper fibres, facing the chassis 3.

[0048] Similarly, the bar 14, integral with the axle 5, has stretched lower fibres and shortened upper fibres and the bridges 15 detect said deformation.

[0049] In the preferred embodiment illustrated, the load detector 13 is located below the axle 5, to measure the lengthening of the stretched fibres.

[0050] More specifically, the bar 14 is rendered integral with the lower part of the axle 5 and the bridges 15 are in turn glued underneath the bar 14.

[0051] In alternative embodiments not illustrated, the device 1 has only one bridge 15, or only one simple strain gauge 16, just as efficient in managing truck 2 stability, as described below, more economical but less reliable than the embodiment with two bridges in terms of service continuity.

[0052] The bar 14 may also be attached to the top of the axle 5 and the bridges 15 (or simple strain gauges 16) glued in place so that they detect the shortening of the upper fibres.

[0053] In particular with reference to Figures 2b and 2c, it should be noticed that the strain gauge bridges 15 or simple strain gauges 16 are located in different positions to those in Figure 2a and may be directly glued to the rear axle 5 so that they detect the deformations directly without insertion of the bar 14 in between.

[0054] In particular, they may be attached to the axle 5 at an axle oscillating pivot 5d, or they may be attached at wheel 7 supporting pins 5c.

[0055] Moreover, advantageously, a strain gauge bridge 15 may be attached to each half-part 5b of the axle 5.

[0056] In the case of the device 1, in the preferred embodiment illustrated, the bar 14 and the bridge 15 are clamped to the axle 5 with the truck 2 completely unloaded and without the driver OP, to supply a substantially null value analogue signal in this condition, that is to say, with the axle 5 only subject to the weight of the truck 2.

[0057] The analogue signal from the bridge 15 varies with increases or reductions in the overall load on the rear axle 5. In particular, the percentage value increases when the axle 5 itself becomes lighter.

[0058] In this way, the analogue signal contains information about the distribution of the weights relative to the rear axle 5, that is to say, as described in more detail below, relative to the truck 2 equilibrium.

[0059] The bridges 15, or simple strain gauges 16, in general form a strain gauge transducer 17.

[0060] The latter is connected at the input of the processing unit 18 which receives the analogue signal detected by the bridges 15 or the simple strain gauges 16.

[0061] Obviously, the processing unit 18 is made differently and appropriately if it must process signals from bridges 15 or from simple strain gauges 16.

[0062] In this embodiment a first stage of the unit 18 comprises an analogue conditioning device 19.

[0063] The device 19 is designed to acquire and condition the signal from the transducer 17 to remove from it any interference and errors normally due to dispersion of the electrical characteristics in the load detector 13.

[0064] By way of example, the device 19 may comprise a differential amplifier 20 for instruments, of the substantially known type and therefore not described in detail.

[0065] Downstream of the device 19, according to a direction of data feed A, the processing unit 18 comprises an analogue - digital converter 21 for converting the analogue signal into a digital signal. For example, the converter 21 is of the 10 bit type with a 1 kHz conversion speed.

[0066] Advantageously, in alternative embodiments not illustrated, the converter 21 may be of any type and have different characteristic parameters, depending on the required speed and resolution.

[0067] In this embodiment, the processing unit 18 comprises, downstream of the converter 21 according to the direction A, a computerised check and control unit 22, which, at its input, has a digital conditioning device 23 designed to modulate the digital signal generated by the converter 21.

[0068] In more detail, in the preferred embodiment illustrated, the device 23 comprises, one after another according to the direction A, a digital amplifier 24 with filter, a digital filter 25 and a digital amplifier 26 with hysteresis.

[0069] The amplifiers 24 and 26 and the filter 25 are of the substantially known type, therefore they are not described in detail, and transmit the suitably cleaned up and modulated digital signal downstream according to the direction A.

[0070] The digital signal modulated in this way indicates the distribution of the weights relative to the rear axle 5 and will be referred to, in the description below, as the load indication or signal C, relative to the rear axle 5.

[0071] A processor 27 is connected to the digital conditioning device 23, receives the signal C as input, and implements a device 1 use and operation strategy, an example of which is described below.

[0072] Downstream of the check and control unit 22, in particular of the processor 27, according to the direction A, the device 1 comprises an interface 28 located and active between the unit 22 and the communication channel 12.

[0073] In particular, the interface 28 allows the check and control unit 22 to acquire most of the above-mentioned instructions and information about truck 2 operation, which substantially pass from the truck to the check and control unit 22 according to a direction B.

[0074] The same instructions and information are returned, according to the direction A, to the truck 2, suitably reprocessed, substantially according to the above-mentioned load indication C.

[0075] The indicator device 29 is located on the truck 2 close to the driving position 2a and is controlled by the check and control unit 22 processor 27.

[0076] The device 29 described above has a visual warning device 29a, for example a set of LEDs in different colours, and an acoustic alarm 29b of the known type and therefore not described in detail.

[0077] It may be assumed, for example and for the sake of simplicity, that there are four yellow LEDs, two green LEDs and one red LED forming a LED scale and constituting the visual warning device 29a, and a buzzer constituting the acoustic alarm 29b. Advantageously, there may be any number of LEDs in any colours, according to the type of visual indication to be supplied; the visual warning device 29a may also comprise an indicator with a pointer movable on a graduated scale.

[0078] The device 29, including the LEDs and the buzzer, together with the communication channel 12 and the interface 28, forms safety means 30. Similarly, the load detector 13 together with the bar 14, the Wheatstone bridge or bridges 15 and the strain gauges, forms the means 31 for acquiring information about the truck 2 equilibrium.

[0079] In practice, when the truck 2 lifts a heavy load or a load X to a height greater than that allowed, the detector 50 sends the weight signal P and the distance signal D to the unit 18 which processes the signals. After the processing described above, performed by the unit 18, a signal S, S1 or S2 is sent to the safety means 30. At this point, if the signal represents a truck 2 risk status, the means 30 stop the lifting apparatus 8 or warn the operator OP acoustically/visually.

[0080] In addition, or alternatively, considering the truck 2 longitudinal equilibrium in any operating condition, it should be noticed that, in the case of front tipping forward, of particular interest in this text, the overall weight of the truck 2 is transferred towards the front axle 4, which tends to become the only point at which the truck 2 makes contact with the ground.

[0081] In other words, as a front tipping condition approaches, the weight sustained by the rear axle 5 tends to be reduced to zero and the axle 5 tends to be completely unloaded.

[0082] The strain gauge transducer 17, substantially measuring the bending of the axle 5 with the change in truck 2 use and load conditions, produces the signal C, which is an indicator of the truck 2 equilibrium.

[0083] As already indicated, in the preferred embodiment illustrated, the signal C is acquired and modulated in such a way that the signal C increases as a positive percentage gradually as the rear axle 5 is unloaded.

[0084] The block diagram in Figure 3 is described in detail in the flow charts illustrated in Figures 4a to 4e.

[0085] It should be noticed that the data about the truck 2 is acquired in operating blocks 102, 112 and 118 and, as indicated, during actual operation the data comes from the communication channel 12 according to the direction verso B, whilst comparison constants and parameters come from memory cells, not illustrated, which can be used by the processing unit 18.

[0086] In a substantially similar way, the instructions or commands implemented in the operating blocks 202, 203 and 204 are made available, during actual operation, on the communication channel 12 by the respective operating blocks 111, 117 and 124.

[0087] With reference to Figure 4a, it should be noticed that the schematic blocks 200 and 201 can be represented, in the flow chart, simply as a start operating block 100 and a calculating operating block 101 where the signal C is quantified and sent to the next blocks.

[0088] With reference to Figure 4b, the flow chart illustrated schematises the procedure for calculating LUP1 and LDOWN1 command ramps for the slide 10 upstroke and downstroke according to the LUP and LDOWN commands set by the driver OP and a limit LO on the slide 10 upstroke and downstroke speed.

[0089] In operating block 103 the truck 2 speed of movement V is compared with a reference value V1, for example 6 km/h. If the speed V is greater than V1 the slide 10 is stopped at a height 'hL' equal to a limit value, for example 100 cm (operating block 104).

[0090] Then, in operating block 105, the signal C is assessed and if it is greater than 95%, the slide 10 upstroke is stopped and inhibited, setting a null LUP command (operating block 106); advantageously, it is still possible to lower the slide 10.

[0091] If the signal C is greater than 85% but less than 95% (operating block 107), the slide 10 upstroke command LUP is limited to a minimum value LMIN, at operating block 108.

[0092] In operating block 109 the LUP1 and LDOWN1 ramps are calculated as a function R of the LUP, LDOWN commands and of time constants RC1 and RC2.

[0093] Said ramps are calculated to soften the LUP and LDOWN commands, normally of the step type, set by the driver OP for the truck 2, according to the constants RC1 and RC2.

[0094] In operating block 110 another limit LO is implemented on the slide 10 movement speed, both up and down, according to the LUP1 and LDOWN1 commands, calculated in operating block 109, and according to a constant L1, relative to the "weight" that the signal C must have in LO, and the signal C itself.

[0095] As indicated, the operator 111 makes the results available for the respective uses.

[0096] Considering Figure 4c, the flow chart illustrated relates to the implementation of the TUP1, TDOWN1 commands for mast 9 swinging according to the TUP, TDOWN commands, respectively relative to mast 9 angling backwards towards the truck and forward, set by the truck 2 driver OP.

[0097] In operating block 113 the signal C is assessed and, if it is greater than 85%, mast 9 forward swinging is stopped (TDOWN=0, block 114).

[0098] In operating block 115 the TUP1 and TDOWN1 command signals are then calculated, that is to say, the TUP and TDOWN commands are modulated, substantially in steps, according to respective time constants RC3 and RC4, to make their execution less sudden.

[0099] In operating block 116 a limit value TO is calculated for the swinging speed, both forward and backward, according to the new TUP1, TDOWN1 commands, to C and to a constant L2 indicating the incidence of the signal C required in the calculation of TO.

[0100] With reference to Figure 4d, the flow chart relative to limitation of the truck 2 speed V should be noticed.

[0101] In operating block 119 the slide 10 height 'hL' is compared with a reference value, for example 100 cm, and if the slide height exceeds the reference height the truck speed 2 cannot exceed a speed limit value L4 (operating block 120).

[0102] If the signal C is greater than 95% (operating block 121), the truck 2 speed V is limited to a value equivalent to half the limit L4 in operating block 122.

[0103] In operating block 123 a command VO is then calculated to adjust the speed V according to command VI set by the driver OP, and according to the actual truck 2 speed V and the signal C.

[0104] In parallel with the manoeuvres described deriving from the implementation of instructions for the truck 2 intended to reduce all static and dynamic phenomena which may jeopardise stability, the processor 27 also implements a strategy for indicating the truck 2 equilibrium condition.

[0105] With reference to Figure 4e, notice, downstream of an operating block 125 for zeroing the LED scale, a set of operating blocks (from 126 to 134) where the signal C is compared in succession with greater percentage limit values.

[0106] Each comparison produces (operating blocks 135 to 143) a different indication gradually as the truck 2 equilibrium becomes more precarious.

[0107] In the case of the indicator device 29 described by way of example, the first four LEDs are green, the firth and sixth are yellow, whilst the seventh is red.

[0108] The branches of the single flow chart illustrated in Figures 4b to 4e all terminate with a respective end of calculation operating block numbered from 400b to 400e.

[0109] It should be noticed that the check strategy, described by way of example and without in any way limiting the scope of the inventive concept, is continuously and cyclically implemented during truck 2 operation, that is to say, after the respective end blocks, implementation restarts substantially from block 201 illustrated in Figure 3.

[0110] The control and check functions originating from the computerised unit 22 are not described in detail since they are not part of the present invention.

[0111] The methods for carrying out commands and/or correcting commands set by the driver OP may be substantially known.

[0112] For example, with reference to details not illustrated, since the lifting apparatus 8 is normally hydraulic, corrections to the swinging or upstroke speed may be made by increasing or reducing the delivery of oil in the pipes, by adjusting the speed of rotation of the pumps, which are normally electric.

[0113] Similarly, adjustments may be made to the flow rate of oil in electroproportional valves.

[0114] The invention brings important advantages.

[0115] Firstly, the truck 2 has an automatic device 1 which stops the lifting apparatus 8 every time the operator is lifting an excessive load X or is lifting a load to a height which jeopardises truck 2 stability. Advantageously, the operator does not need to assess the weight, nor the height of the load X, since the device 1 independently checks the weight and the height.

[0116] Moreover, the signal C obtained based on the instantaneous deformations of the rear axle 5 represents the equilibrium of the entire truck 2 about the front axle 4.

[0117] Geometrically, considering the truck 2 longitudinal equilibrium, it should be noticed that the overall weight is substantially distributed on the two axles 4 and 5, therefore, the rear axle 5 gradually becoming lighter, with its consequent deformations, indicates a tendency to tip forward.

[0118] It should be noticed that an approach of this type produces a real image of truck 2 stability and becomes an aid for the truck 2 driver.

[0119] Moreover, the device 1, with a simple structure and user-friendly, is easily adapted for any fork lift truck of the type with four wheels and even for fork lift trucks with three wheels or with twin rear wheels, in which the load on the rear axle can be measured.

[0120] The commands implemented, substantially according to the truck 2 equilibrium, modulate the commands provided by the driver, making the truck 2 more stable, reducing the risks for the driver and assisting him with manoeuvres.

[0121] The invention described may be subject to modifications and variations without thereby departing from the scope of the inventive concept as described in the claims herein.

Claims

1. A safety device for a fork lift truck (2), comprising means (31) for acquiring information relative to the load (X) lifted by a lifting apparatus (8) of a fork lift truck (2), said lifting apparatus (8) being attached to a chassis (3) at a front axle (4) fitted with respective wheels (6) of said fork lift truck (2) and comprising a mast (9), whereby a slide (10) slides along the mast from the bottom to the top and vice versa, the safety device further comprising a processing unit (18) connected to the acquisition means (31), and safety means (30) which act on the truck (2) following a signal (S, S1, S2) processed by the processing unit (18); wherein the acquisition means (31) comprise a load detector (13) attachable to a rear axle (5) fitted with respective wheels (7) of the fork lift truck (2), said load detector (13) generating a signal (C) indicating the distribution of the weights relative to the rear axle (5);
the safety device being **characterized in that** the processing unit (18) receives the signal (C) and calculates command ramps (LUP1, LDOWN1) for the slide (10) upstroke and downstroke according to commands (LUP, LDOWN) set by the driver (OP) and calculates a limit (LO) on the slide (10) upstroke and downstroke speed, said limit (LO) on the slide (10) upstroke and downstroke speed depending on said signal (C).

2. The device according to claim 1, **characterised in that**, for calculating said upstroke and downstroke command ramps (LUP1, LDOWN1), the processing unit (18) compares the truck (2) speed of movement (V) with a reference value (V1) and, if the speed (V) of the truck is greater than the reference value (V1), stops the slide (10) at a height (hL) equal to a limit value.

3. The device according to claim 2, **characterised in that** the processing unit (18) assesses the signal (C) and, if said signal (C) is greater than 95%, stops the slide (10) upstroke.

4. The device according to claim 3, **characterised in that** the processing unit (18) assesses the signal (C) and, if the signal (C) is greater than 85% but less than 95%, limits the slide (10) upstroke command (LUP) to a minimum value (LMIN).

5. The device according to claim 4, **characterised in that** the processing unit (18) calculates the ramps (LUP1. LDOWN1) as a function (R) of the commands (LUP, LDOWN) set by the driver (OP) and of time constants (RC1, RC2).

6. The device according to claim 5, **characterised in that** the processing unit (18) implements the limit (LO) on the slide (10) upstroke and downstroke speed according to the ramps (LUP1, LDOWN1), according to a constant (L1), relative to the weight that the signal (C) must have in the limit (LO), and according to said signal (C).

7. The device according to claim 1, **characterised in that** the processing unit (18) receives the signal (C) and calculates commands (TUP1, TDOWN1) for mast (9) swinging, according to the commands (TUP, TDOWN) set by the driver (OP), respective relative to mast (9) angling backwards towards the truck and forward.

8. The device according to claim 7, **characterised in that**, for calculating said swinging command ramps (TUP1, TDOWN1), the processing unit (18) assesses the signal (C) and, if said signal (C) is greater than 85%, stops the mast (9) forward swinging.

9. The device according to claim 8, **characterised in that** the processing unit (18) calculates said swinging command ramps (TUP1, TDOWN1) by modulating the commands (TUP, TDOWN) set by the driver

(OP) in steps, according to respective time constants (RC3, RC4).

10. The device according to claim 9, **characterised in that** the processing unit (18) calculates a limit value (TO) for the swinging speed, both forward and backward, according to the swinging command ramps (TUP1, TDOWN1), according to the signal (C) and according to a constant (L2) indicating the incidence of the signal (C) required in the calculation of said swinging speed limit value (TO).

11. The device according to claim 1, **characterised in that** the processing unit (18) limits the truck (2) speed (V).

12. The device according to claim 11, **characterised in that**, for limiting the truck (2) speed (V), the processing unit (18) compares the slide (10) height (hL) with a reference value and, if the slide height exceeds the reference height, the truck speed (2) cannot exceed a speed limit value (L4).

13. The device according to claim 12, **characterised in that**, if the signal (C) is greater than 95%, the truck (2) speed (V) is limited to a value equivalent to half the speed limit value (L4).

14. The device according to claim 13, **characterised in that** the processing unit (18) calculates a command (VO) to adjust the speed (V) according to a command (VI) set by the driver (OP), according to the actual truck (2) speed (V) and according to the signal (C).

15. The device according to claim 1, **characterised in that** it further indicates the truck (2) equilibrium condition.

16. The device according to claim 15, **characterised in that**, for indicating the truck (2) equilibrium condition, the processing unit (18) zeroes a LED scale, compares the signal (C) in succession with greater percentage limit values and produces a different indication gradually as the truck (2) equilibrium becomes more precarious.

17. The device according to claim 1, **characterised in that** the detector further comprises: a weight sensor (51) for measuring a weight value (P) for the load (X) lifted, and a height sensor (52) for measuring a distance value (D) from the base (54a) of the chassis (3) to the load (X).

18. The device according to claim 17, **characterised in that** the processing unit (18) compares the weight value (P) and distance value (D) and detects whether or not the weight value (P) and distance value (D) are greater than a preset load and height safety values.

19. The device according to claim 18, **characterised in that** the processing unit (18) compares the weight value (P) with a nominal load value; if said weight value (P) is greater than the nominal load value, the processing unit (18) performs a comparison to check if the distance value (D) is greater than a nominal height value; if the distance value (D) is also greater than the nominal height value, a signal (S1) is sent representing a risk status for the load (X) lifted.

20. The device according to claim 19, **characterised in that**, if the weight value (P) is less than the nominal load value or if the weight value (P) is greater than the nominal load value but the distance value (D) is less than the nominal height value, the processing unit (18) further compares a reduced load and a reduced height values respectively with the weight value (P) and distance value (D); said reduced load value consisting of a weight value which depends on the height and said reduced height value representing a distance value which depends on the load; if the weight value (P) is less than the reduced load value, a signal (S) representing a safe status for the load (X) lifted is sent.

21. The device according to claim 20, **characterised in that**, if the weight value (P) is greater than the reduced load value, the processing unit (18) performs a comparison to check if the distance value (D) is greater than the reduced height value; if the distance value (D) is lower than the reduced height value, then the signal (S) representing the safe status is sent; if the distance value (D) is greater than the reduced height value, a signal (S2) representing a risk status for the load (X) lifted is sent.

22. A fork lift truck **characterised in that** it comprises a safety device according to claims 1 to 21.

23. The truck according to claim 22 when depending on claim 17, **characterised in that** the weight sensor (51) is attached to a lifting apparatus (8) slide (10) set up to lift the load (X).

24. The truck according to claim 22 when depending on claim 17, **characterised in that** the weight sensor (51) is attached to a lifting apparatus (8) piston (11), the piston (11) acting on a slide (10) for lifting the load (X).

25. The truck according to claim 23 or 24, **characterised in that** the height sensor (52) comprises a transmitter element (53) attached to the slide (10) for sending an ultrasound signal (U) and a receiver element (54) attached to a base portion (54a) of the chassis (3) for picking up said ultrasound signal (U).

26. The truck according to claim 25, **characterised in that** the height sensor (52) also comprises a block (55) for processing the ultrasound signal picked up by the receiver element (54); said processing block (55) supplying the value representing the distance (D) according to the speed of the ultrasound signal (U) and the time the signal (U) takes to be picked up by the receiver element (54).

27. The truck according to claim 22 when depending on claim 1, **characterised in that** the load detector (13) comprises a strain gauge transducer (17) integral with the rear axle (5), said information being determined by a bending deformation of the rear axle (5).

Patentansprüche

1. Sicherheitsvorrichtung für einen Gabelstapler (2), die Einrichtungen (31) für die Erfassung von Informationen bezüglich der Last (X) beinhaltet, die von einem Hubgerüst (8) eines Gabelstaplers (2) angehoben wird, wobei das Hubgerüst (8) an einem Fahrwerk (3) an einer mit entsprechenden Rädern (6) des Gabelstaplers (2) versehenen Vorderachse (4) angebracht ist und einen Mast (9) beinhaltet, wobei ein Schlitten (10) von unten nach oben und umgekehrt den Mast entlang gleitet; wobei die Sicherheitsvorrichtung ferner eine Verarbeitungseinheit (18), die mit den Erfassungseinrichtungen (31) verbunden ist, sowie Sicherheitseinrichtungen (30) beinhaltet, die infolge eines von der Verarbeitungseinheit (18) verarbeiteten Signals (S, S1, S2) auf den Gabelstapler (2) einwirken; worin die Erfassungseinrichtungen (31) einen Lastdetektor (13) beinhalten, der an einer mit entsprechenden Rädern (7) des Gabelstaplers (2) versehenen Hinterachse (5) angebracht werden kann, und worin der Lastdetektor (13) ein Signal (C) erzeugt, das die Gewichtsverteilung bezogen auf die Hinterachse (5) angibt;
wobei die Sicherheitsvorrichtung **dadurch gekennzeichnet ist, dass** die Verarbeitungseinheit (18) das Signal (C) empfängt und Befehlsrampen (LUP1, LDOWN1) für den Aufwärtshub und Abwärtshub des Schlittens (10) entsprechend der vom Staplerführer (OP) eingestellten Befehle (LUP, LDOWN) und entsprechend eines Grenzwertes (LO) für die Aufwärtshub- und Abwärtshubgeschwindigkeit des Schlittens (10) berechnet, wobei der Grenzwert (LO) für die Aufwärtshub- und Abwärtshubgeschwindigkeit des Schlittens (10) von dem Signal (C) abhängig ist.

2. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) zur Berechnung der Befehlsrampen (LUP1, LDOWN1) für den Aufwärtshub und Abwärtshub die Bewegungsgeschwindigkeit (V) des Gabelstaplers (2) mit einem Referenzwert (V1) vergleicht und, falls die Geschwindigkeit (V) des Gabelstaplers größer ist als der Referenzwert (V1), den Schlitten (10) in einer Höhe (hL) stoppt, die einem Grenzwert entspricht.

3. Vorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) das Signal (C) überprüft und, falls das Signal (C) größer als 95% ist, den Aufwärtshub des Schlittens (10) stoppt.

4. Vorrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) das Signal (C) überprüft und, falls das Signal (C) größer als 85% aber kleiner als 95% ist, den Befehl für den Aufwärtshub (LUP) des Schlittens (10) auf einen Mindestwert (LMIN) begrenzt.

5. Vorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) die Rampen (LUP1, LDOWN1) als eine Funktion (R) der vom Staplerführer (OP) eingestellten Befehle (LUP, LDOWN) und der Zeitkonstanten (RC1, RC2) berechnet.

6. Vorrichtung nach Anspruch 5, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) den Grenzwert (LO) für die Aufwärtshub- und Abwärtshubgeschwindigkeit des Schlittens (10) entsprechend der Rampen (LUP1, LDOWN1), entsprechend einer Konstanten (L1), die auf das Gewicht bezogen ist, das dem Signal (C) bei der Bestimmung des Grenzwertes (LO) zukommen soll, und entsprechend des Signals (C) implementiert.

7. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) das Signal (C) empfängt und die Befehle (TUP1, TDOWN1) für das Schwenken des Mastes (9) entsprechend der vom Staplerführer (OP) eingestellten Befehle (TUP, TDOWN) berechnet, die sich jeweils auf die Neigung des Mastes (9) nach hinten zum Stapler hin bzw. nach vorne beziehen.

8. Vorrichtung nach Anspruch 7, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) zur Berechnung der genannten Schwenkbefehlsrampen (TUP1, TDOWN1) das Signal (C) überprüft und, falls das Signal (C) größer ist als 85%, die Vorwärtsneigung des Mastes (9) stoppt.

9. Vorrichtung nach Anspruch 8, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) die Schwenkbefehlsrampen (TUP1, TDOWN1) berechnet, indem die vom Staplerführer (OP) eingestellten Befehle (TUP, TDOWN) schrittweise entsprechend jeweiliger Zeitkonstanten (RC3, RC4) moduliert werden.

10. Vorrichtung nach Anspruch 9, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) einen Grenzwert (TO) für die Schwenkgeschwindigkeit, sowohl vorwärts als auch rückwärts, entsprechend der Schwenkbefehlsrampen (TUP1, TDOWN1), entsprechend des Signals (C) und entsprechend einer Konstanten (L2) berechnet, die den für die Berechnung des Geschwindigkeitsgrenzwertes (TO) für die Schwenkbewegung erforderlichen Einfluss des Signals (C) angibt.

11. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) die Geschwindigkeit (V) des Gabelstaplers (2) begrenzt.

12. Vorrichtung nach Anspruch 11, **dadurch gekennzeichnet, dass** zur Begrenzung der Geschwindigkeit (V) des Gabelstaplers (2) die Verarbeitungseinheit (18) die Höhe (hL) des Schlittens (10) mit einem Referenzwert vergleicht und, falls die Schlittenhöhe die Referenzhöhe übersteigt, die Geschwindigkeit des Gabelstaplers (2) einen bestimmten Geschwindigkeitsgrenzwert (L4) nicht übersteigen kann.

13. Vorrichtung nach Anspruch 12, **dadurch gekennzeichnet, dass**, falls das Signal (C) größer ist als 95%, die Geschwindigkeit (V) des Gabelstaplers (2) auf einen Wert begrenzt ist, der gleich der Hälfte des Geschwindigkeitsgrenzwertes (L4) ist.

14. Vorrichtung nach Anspruch 13, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) einen Befehl (VO) berechnet, um die Geschwindigkeit (V) entsprechend eines vom Staplerführer (OP) eingestellten Befehls (VI), entsprechend der tatsächlichen Geschwindigkeit (V) des Gabelstaplers (2) und entsprechend des Signals (C) zu justieren.

15. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** sie ferner den Gleichgewichtszustand des Gabelstaplers (2) anzeigt.

16. Vorrichtung nach Anspruch 15, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) zur Anzeige des Gleichgewichtszustandes des Staplers (2) eine LED-Skala auf Null setzt, das Signal (C) nacheinander mit größeren prozentuellen Grenzwerten vergleicht und nach und nach eine unterschiedliche Anzeige erzeugt, während das Gleichgewicht des Staplers (2) zunehmend beeinträchtigt wird.

17. Vorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** der Detektor ferner Folgendes beinhaltet: einen Gewichtssensor (51) zum Messen eines Gewichtswertes (P) für die angehobene Last (X) und einen Höhensensor (52) zum Messen eines Abstandswertes (D) von der Basis (54a) des Fahrwerks (3) bis zur Last (X).

18. Vorrichtung nach Anspruch 17, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) den Gewichtswert (P) und den Abstandswert (D) vergleicht und erkennt, ob der Gewichtswert (P) und der Abstandswert (D) die voreingestellten Sicherheitswerte für die Last und die Höhe überschreiten oder nicht.

19. Vorrichtung nach Anspruch 18, **dadurch gekennzeichnet, dass** die Verarbeitungseinheit (18) den Gewichtswert (P) mit einem Lastnennwert vergleicht; wenn dieser Gewichtswert (P) größer ist als der Lastnennwert, führt die Verarbeitungseinheit (18) einen Vergleich durch, um zu prüfen, ob der Abstandswert (D) größer ist als ein Höhennennwert; wenn auch der Abstandswert (D) größer ist als der Höhennennwert, wird ein Signal (S1) ausgesendet, das einen Gefahrzustand für die angehobene Last (X) anzeigt.

20. Vorrichtung nach Anspruch 19, **dadurch gekennzeichnet, dass**, wenn der Gewichtswert (P) niedriger ist als der Lastnennwert oder wenn der Gewichtswert (P) größer ist als der Lastnennwert, aber der Abstandswert (D) niedriger ist als der Höhennennwert, die Verarbeitungseinheit (18) ferner jeweils einen reduzierten Lastwert und einen reduzierten Höhenwert mit dem Gewichtswert (P) bzw. dem Abstandswert (D) vergleicht; wobei der reduzierte Lastwert in einem höhenabhängigen Gewichtswert besteht und der reduzierte Höhenwert einen lastabhängigen Abstandswert darstellt; und wobei, wenn der Gewichtswert (P) niedriger ist als der reduzierte Lastwert, ein Signal (S) ausgesendet wird, das einen Sicherheitszustand für die angehobene Last (X) anzeigt.

21. Vorrichtung nach Anspruch 20, **dadurch gekennzeichnet, dass**, wenn der Gewichtswert (P) größer ist als der reduzierte Lastwert, die Verarbeitungseinheit (18) einen Vergleich durchführt, um zu prüfen, ob der Abstandswert (D) größer ist als der reduzierte Höhenwert; wenn der Abstandswert (D) niedriger ist als der reduzierte Höhenwert, wird das Signal (S) zur Anzeige des Sicherheitszustands ausgesendet; wenn der Abstandswert (D) größer ist als der reduzierte Höhenwert, wird ein Signal (S2) zur Anzeige eine Gefahrzustandes für die angehobene Last (X) ausgesendet.

22. Gabelstapler, **dadurch gekennzeichnet, dass** er eine Sicherheitsvorrichtung nach den Ansprüchen 1 bis 21 enthält.

23. Gabelstapler nach Anspruch 22, sofern von Anspruch 17 abhängig, **dadurch gekennzeichnet,**

dass der Gewichtssensor (51) an einem Schlitten (10) des Hubgerüstes (8) angebracht ist, der für das Anheben der Last (X) ausgelegt ist.

24. Gabelstapler nach Anspruch 22, sofern von Anspruch 17 abhängig, **dadurch gekennzeichnet, dass** der Gewichtssensor (51) an einem Kolben (11) des Hubgerüstes (8) angebracht ist, wobei der Kolben (11) auf einen Schlitten (10) zum Anheben der Last (X) wirkt.

25. Gabelstapler nach Anspruch 23 oder 24, **dadurch gekennzeichnet, dass** der Höhensensor (52) ein an dem Schlitten (10) angebrachtes Senderelement (53) zum Aussenden eines Ultraschallsignals (U) und ein an einem unteren Abschnitt (54a) des Fahrwerks (3) angebrachtes Empfängerelement (54) zum Empfangen des genannten Ultraschallsignals (U) beinhaltet.

26. Gabelstapler nach Anspruch 25, **dadurch gekennzeichnet, dass** der Höhensensor (52) auch einen Block (55) für die Verarbeitung des vom Empfängerelement (54) aufgenommenen Ultraschallsignals beinhaltet;
wobei der Verarbeitungsblock (55) den Wert bereitstellt, der den Abstand (D) entsprechend der Geschwindigkeit des Ultraschallsignals (U) und der bis zum Empfang des Signals (U) durch das Empfängerelement (54) verstrichenen Zeit darstellt.

27. Gabelstapler nach Anspruch 22, sofern von Anspruch 1 abhängig, **dadurch gekennzeichnet, dass** der Lastdetektor (13) einen Dehnungsmessstreifen-Aufnehmer (17) beinhaltet, der fest mit der Hinterachse (5) verbunden ist, wobei die genannte Information durch eine Biegeverformung der Hinterachse (5) bestimmt wird.

Revendications

1. Un dispositif de sécurité pour un chariot élévateur à fourche (2), comprenant des moyens (31) pour acquérir des informations relatives à la charge (X) levée par un dispositif de levage (8) d'un chariot élévateur à fourche (2), ledit dispositif de levage (8) étant fixé sur un châssis (3) au niveau d'un essieu avant (4) équipé de roues (6) respectives dudit chariot élévateur à fourche (2) et comprenant un mât (9), un tablier porte-fourche (10) coulissant le long du mât de bas en haut et inversement, le dispositif de sécurité comprenant en outre une unité de traitement (18) reliée aux moyens d'acquisition (31), et des moyens de sécurité (30) qui agissent sur le chariot (2) suite à un signal (S, S1, S2) traité par l'unité de traitement (18) ; où les moyens d'acquisition (31) comprennent un détecteur de charge (13) pouvant être associé à un essieu arrière (5) équipé de roues (7) respectives du chariot élévateur à fourche (2), ledit détecteur de charge (13) générant un signal (C) indiquant la répartition des poids par rapport à l'essieu arrière (5) ;
ledit dispositif de sécurité étant **caractérisé en ce que** l'unité de traitement (18) reçoit le signal (C) et calcule des rampes de commande (LUP1, LDOWN1) pour la montée et la descente du tablier porte-fourche (10) en fonction de commandes (LUP, LDOWN) données par le conducteur (OP) et en fonction d'une limite (LO) appliquée à la vitesse de montée et de descente du tablier porte-fourche (10), ladite limite (LO) appliquée à la vitesse de montée et de descente du tablier porte-fourche (10) dépendant dudit signal (C).

2. Le dispositif selon la revendication 1, **caractérisé en ce que**, pour calculer lesdites rampes (LUP1, LDOWN1) de commande de montée et de descente, l'unité de traitement (18) compare la vitesse (V) de déplacement du chariot (2) avec une valeur de référence (V1) et, si la vitesse (V) du chariot est supérieure à la valeur de référence (V1), arrête le tablier porte-fourche (10) à une hauteur (hL) égale à une valeur limite.

3. Le dispositif selon la revendication 2, **caractérisé en ce que** l'unité de traitement (18) évalue le signal (C) et, si ledit signal (C) est supérieur à 95 %, arrête la montée du tablier porte-fourche (10).

4. Le dispositif selon la revendication 3, **caractérisé en ce que** l'unité de traitement (18) évalue le signal (C) et, si le signal (C) est supérieur à 85 % mais inférieur à 95 %, limite la commande (LUP) de montée du tablier porte-fourche (10) à une valeur minimum (LMIN).

5. Le dispositif selon la revendication 4, **caractérisé en ce que** l'unité de traitement (18) calcule les rampes (LUP1, LDOWN1) comme une fonction (R) des commandes (LUP, LDOWN) données par le conducteur (OP) et de constantes de temps (RC1, RC2).

6. Le dispositif selon la revendication 5, **caractérisé en ce que** l'unité de traitement (18) applique la limite (LO) sur la vitesse de montée et de descente du tablier porte-fourche (10) en fonction des rampes (LUP1, LDOWN1), en fonction d'une constante (L1), relative au poids que le signal (C) doit avoir dans la limite (LO), et en fonction dudit signal (C).

7. Le dispositif selon la revendication 1, **caractérisé en ce que** l'unité de traitement (18) reçoit le signal (C) et calcule des commandes (TUP1, TDOWN1) pour l'oscillation du mât (9), en fonction des commandes (TUP, TDOWN) données par le conducteur

(OP), concernant une inclinaison en arrière du mât (9) vers le chariot et, respectivement, en avant.

8. Le dispositif selon la revendication 7, **caractérisé en ce que**, pour calculer lesdites rampes (TUP1, TDOWN1) de commande de l'oscillation, l'unité de traitement (18) évalue le signal (C) et, si ledit signal (C) est supérieur à 85 %, arrête l'oscillation en avant du mât (9).

9. Le dispositif selon la revendication 8, **caractérisé en ce que** l'unité de traitement (18) calcule lesdites rampes (TUP1, TDOWN1) de commande de l'oscillation en modulant les commandes (TUP, TDOWN) données par le conducteur (OP), par pas, en fonction de constantes de temps (RC3, RC4) respectives.

10. Le dispositif selon la revendication 9, **caractérisé en ce que** l'unité de traitement (18) calcule une valeur limite (TO) pour la vitesse d'oscillation, tant en avant qu'en arrière, en fonction des rampes (TUP1, TDOWN1) de commande de l'oscillation, en fonction du signal (C) et en fonction d'une constante (L2) indiquant l'incidence que devra avoir le signal (C) dans le calcul de ladite valeur limite (TO) de la vitesse d'oscillation.

11. Le dispositif selon la revendication 1, **caractérisé en ce que** l'unité de traitement (18) limite la vitesse (V) du chariot (2).

12. Le dispositif selon la revendication 11, **caractérisé en ce que**, pour limiter la vitesse (V) du chariot (2), l'unité de traitement (18) compare la hauteur (hL) du tablier porte-fourche (10) avec une valeur de référence et, si la hauteur du tablier porte-fourche dépasse la hauteur de référence, la vitesse du chariot (2) ne peut pas dépasser une valeur limite de vitesse (L4).

13. Le dispositif selon la revendication 12, **caractérisé en ce que**, si le signal (C) est supérieur à 95 %, la vitesse (V) du chariot (2) est limitée à une valeur équivalant à la moitié de la valeur limite de vitesse (L4).

14. Le dispositif selon la revendication 13, **caractérisé en ce que** l'unité de traitement (18) calcule une commande (VO) pour régler la vitesse (V) en fonction d'une commande (VI) définie par le conducteur (OP), en fonction de la vitesse (V) réelle du chariot (2) et en fonction du signal (C).

15. Le dispositif selon la revendication 1, **caractérisé en ce qu'**il indique en outre la condition d'équilibre du chariot (2).

16. Le dispositif selon la revendication 15, **caractérisé en ce que**, pour indiquer la condition d'équilibre du chariot (2), l'unité de traitement (18) met à zéro une échelle de LED, compare le signal (C) en succession avec des valeurs limites croissantes en pourcentage et fournit une indication différente au fur et à mesure que l'équilibre du chariot (2) devient plus précaire.

17. Le dispositif selon la revendication 1, **caractérisé en ce que** le détecteur comprend en outre : un capteur de poids (51) pour mesurer une valeur de poids (P) de la charge (X) à lever, et un capteur de hauteur (52) pour mesurer une valeur de distance (D) de la base (54a) du châssis (3) à la charge (X).

18. Le dispositif selon la revendication 17, **caractérisé en ce que** l'unité de traitement (18) compare la valeur de poids (P) et la valeur de distance (D) et détecte si la valeur de poids (P) et la valeur de distance (D) sont ou non supérieures à des valeurs de sécurité prédéfinies de charge et de hauteur.

19. Le dispositif selon la revendication 18, **caractérisé en ce que** l'unité de traitement (18) compare la valeur de poids (P) avec une valeur de charge nominale ; si ladite valeur de poids (P) est supérieure à la valeur de charge nominale, l'unité de traitement (18) effectue une comparaison pour vérifier si la valeur de distance (D) est supérieure à une valeur de hauteur nominale ; si la valeur de distance (D) est elle aussi supérieure à la valeur de hauteur nominale, un signal (S1) est envoyé indiquant un état de risque de la charge (X) levée.

20. Le dispositif selon la revendication 19, **caractérisé en ce que**, si la valeur de poids (P) est inférieure à la valeur de charge nominale ou si la valeur de poids (P) est supérieure à la valeur de charge nominale mais que la valeur de distance (D) est inférieure à la valeur de hauteur nominale, l'unité de traitement (18) compare encore des valeurs de charge réduite et de hauteur réduite avec, respectivement, la valeur de poids (P) et la valeur de distance (D) ; ladite valeur de charge réduite consistant en une valeur de poids qui dépend de la hauteur et ladite valeur de hauteur réduite représentant une valeur de distance qui dépend de la charge ; si la valeur de poids (P) est inférieure à la valeur de charge réduite, un signal (S) indiquant un état de sécurité de la charge (X) levée est envoyé.

21. Le dispositif selon la revendication 20, **caractérisé en ce que**, si la valeur de poids (P) est supérieure à la valeur de charge réduite, l'unité de traitement (18) effectue une comparaison pour vérifier si la valeur de distance (D) est supérieure à la valeur de hauteur réduite ; si la valeur de distance (D) est inférieure à la valeur de hauteur réduite, le signal (S) indiquant l'état de sécurité est alors envoyé ; si la valeur de distance (D) est supérieure à la valeur de hauteur réduite, un signal (S2) indiquant un état de risque de la charge (X) levée est envoyé.

22. Un chariot élévateur à fourche, **caractérisé en ce qu'**il comprend un dispositif de sécurité selon les revendications de 1 à 21.

23. Le chariot selon la revendication 22 quand dépendant de la revendication 17, **caractérisé en ce que** le capteur de poids (51) est associé à un tablier porte-fourche (10) d'un dispositif de levage (8) configuré pour lever la charge (X).

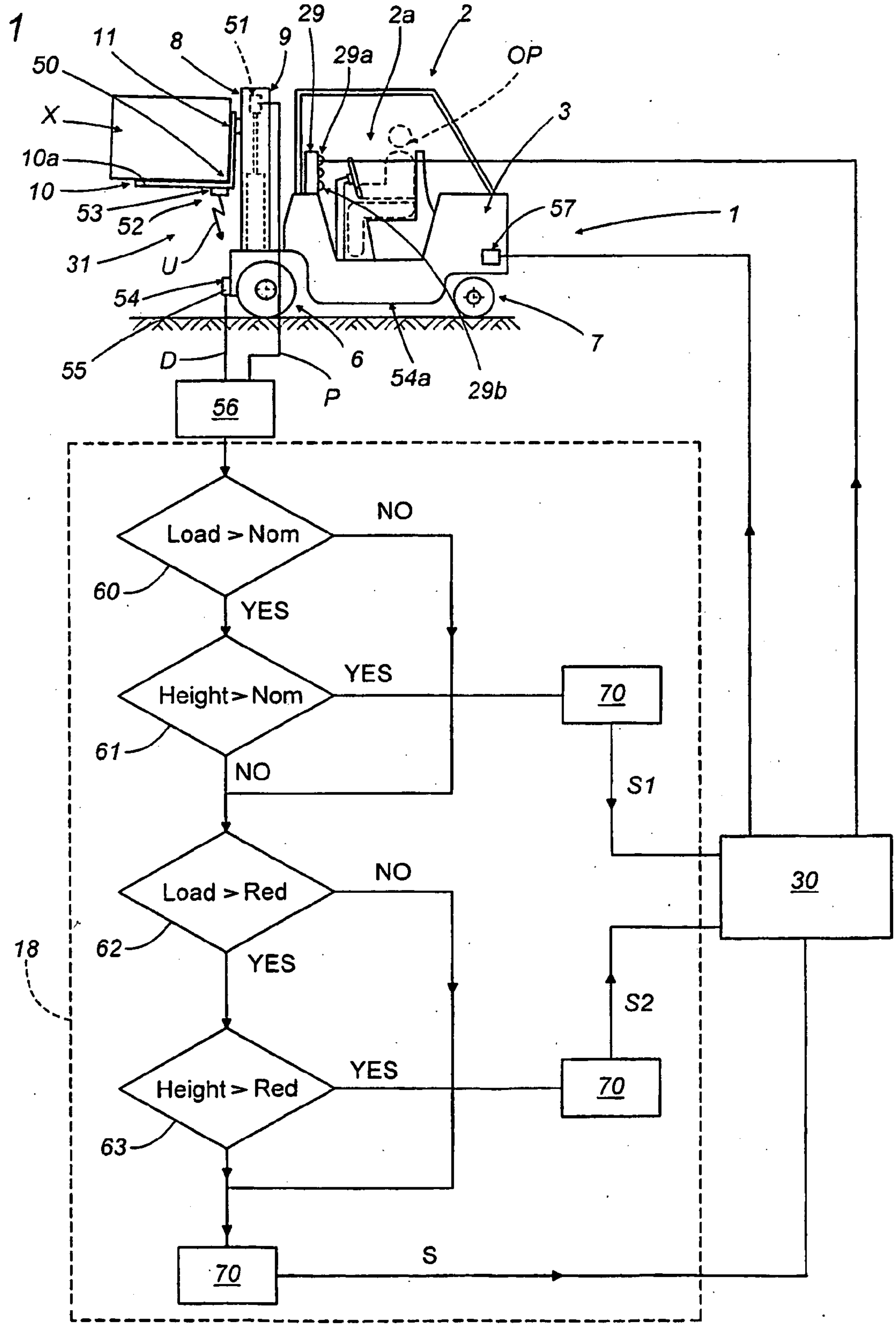
24. Le chariot selon la revendication 22 quand dépendant de la revendication 17, **caractérisé en ce que** le capteur de poids (51) est associé à un piston (11) du dispositif de levage (8), le piston (11) agissant sur un tablier porte-fourche (10) de levage de la charge (X).

25. Le chariot selon la revendication 23 ou 24, **caractérisé en ce que** le capteur de hauteur (52) comprend un élément émetteur (53) associé au tablier porte-fourche (10) pour envoyer un signal à ultrasons (U), et un élément récepteur (54) associé à une portion de base (54a) du châssis (3) pour capter ledit signal à ultrasons (U) .

26. Le chariot selon la revendication 25, **caractérisé en ce que** le capteur de hauteur (52) comprend aussi un bloc (55) destiné à traiter le signal à ultrasons capté par l'élément récepteur (54) ; ledit bloc de traitement (55) fournissant la valeur représentant la distance (D) en fonction de la vitesse du signal à ultrasons (U) et du temps mis par le signal (U) pour être capté par l'élément récepteur (54).

27. Le chariot selon la revendication 22 quand dépendant de la revendication 1, **caractérisé en ce que** le détecteur de charge (13) comprend un transducteur à extensiomètre (17) solidaire de l'essieu arrière (5), ladite information étant déterminée par une déformation de flexion de l'essieu arrière (5) lui-même.

FIG.1



11
8
51
9
29
2a
2
29a
OP
50
X
3
10a
10
57
1
53
52
31
U
54
55
D
6
54a
29b
7
P
56
Load > Nom
NO
60
YES
Height > Nom
YES
70
61
NO
S1
30
Load > Red
NO
62
YES
18
S2
Height > Red
YES
70
63
70
S

FIG.1a

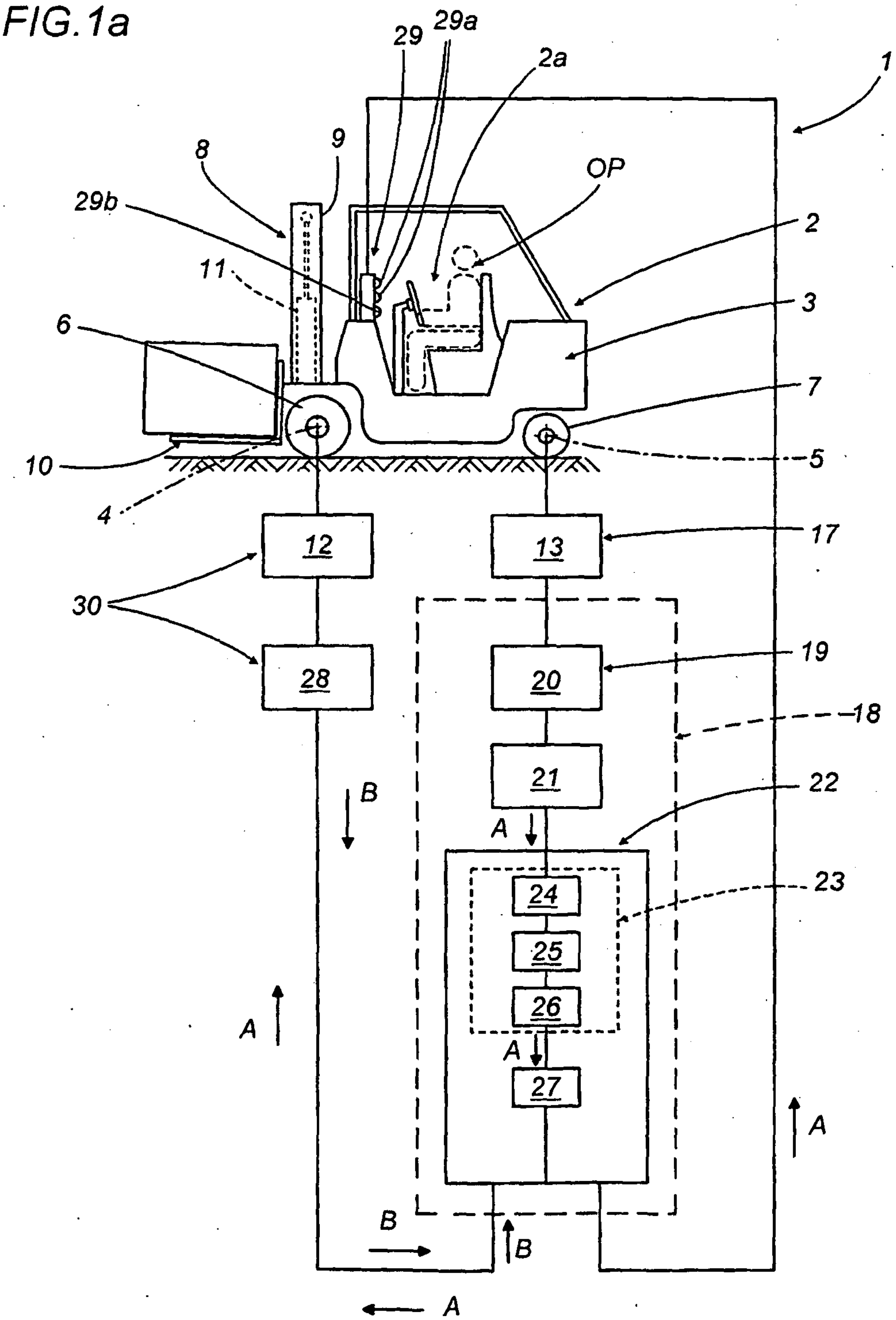

1
2
2a
3
4
5
6
7
8
9
10
11
12
13
17
18
19
20
21
22
23
24
25
26
27
28
29
29a
29b
30
OP
A
B

FIG.2a

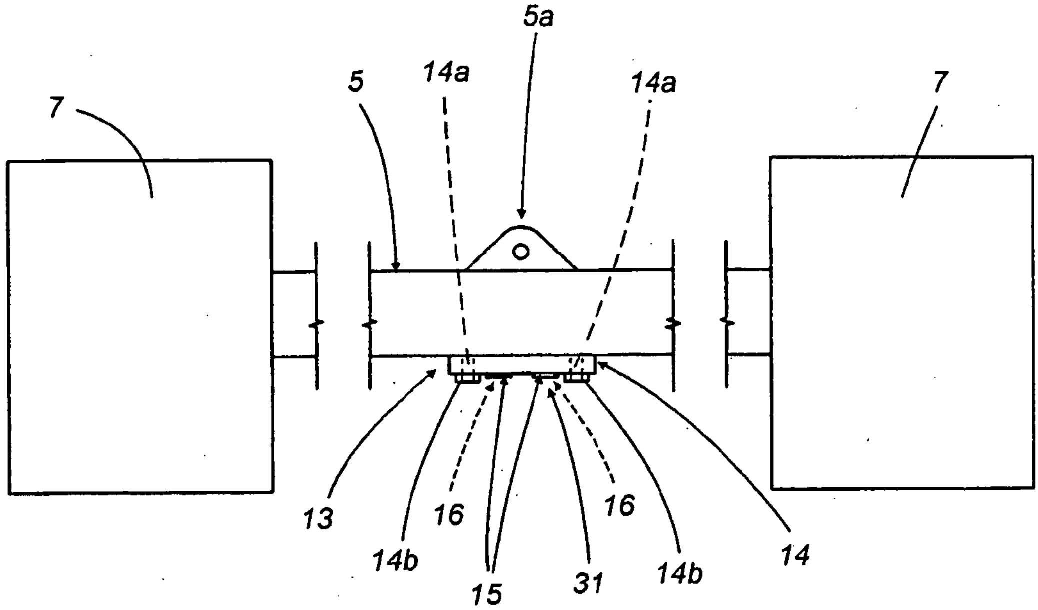


FIG.2b

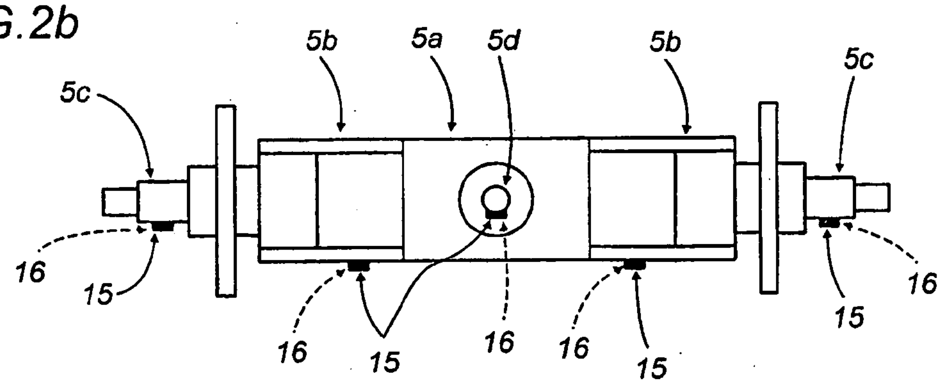


FIG.2c

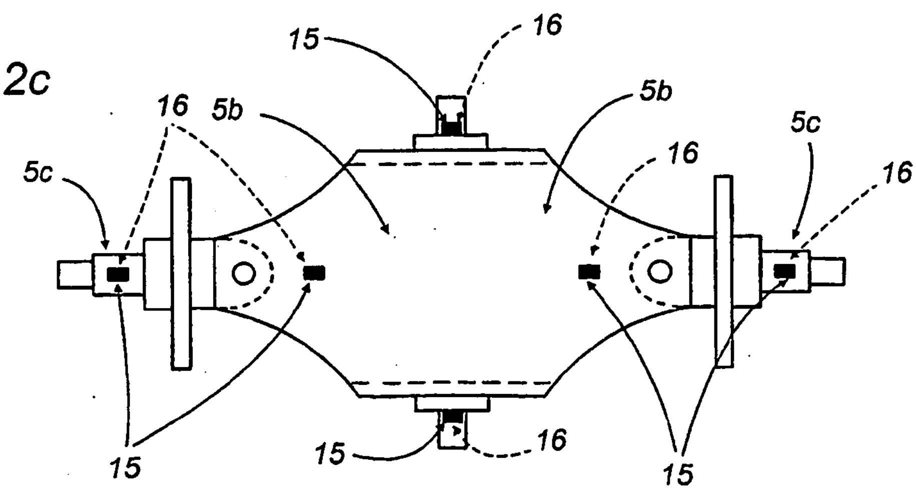


FIG.3

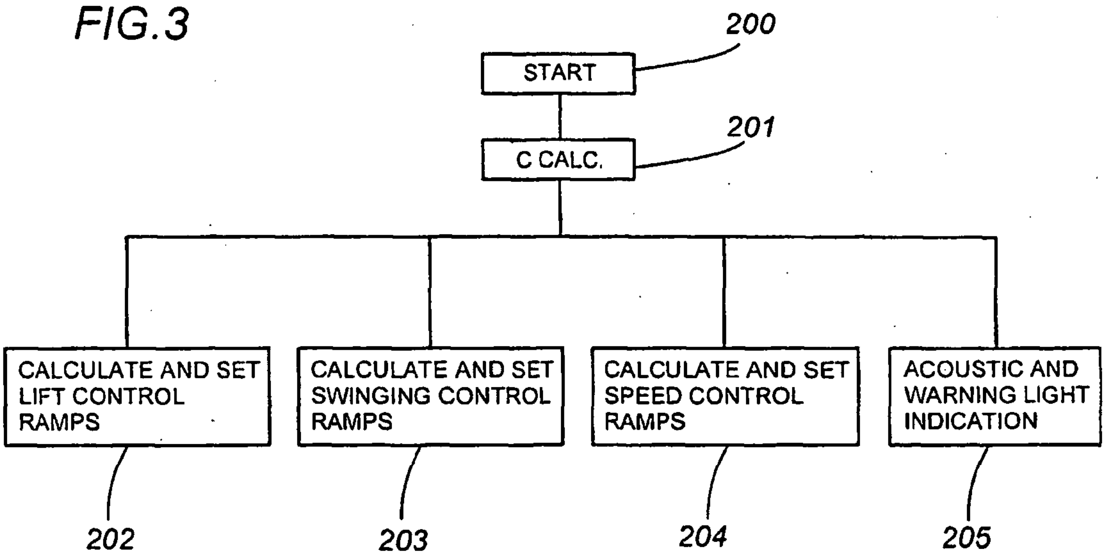

200
START
201
C CALC.
CALCULATE AND SET LIFT CONTROL RAMPS
CALCULATE AND SET SWINGING CONTROL RAMPS
CALCULATE AND SET SPEED CONTROL RAMPS
ACOUSTIC AND WARNING LIGHT INDICATION
202
203
204
205

FIG.4a

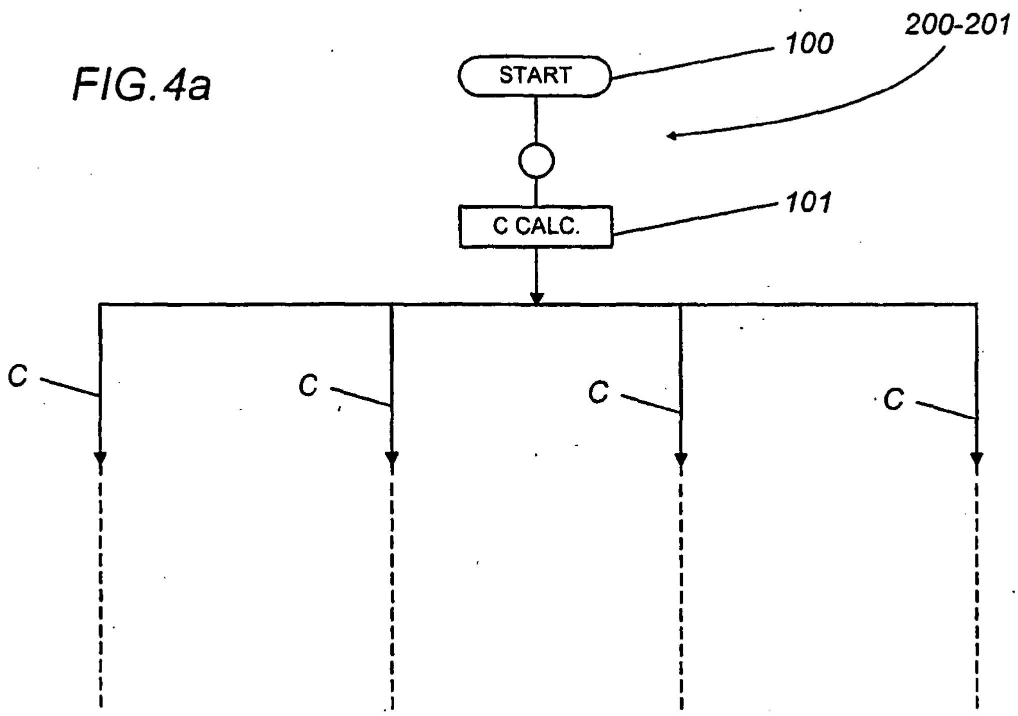

100
200-201
START
101
C CALC.
C
C
C
C

FIG.4b

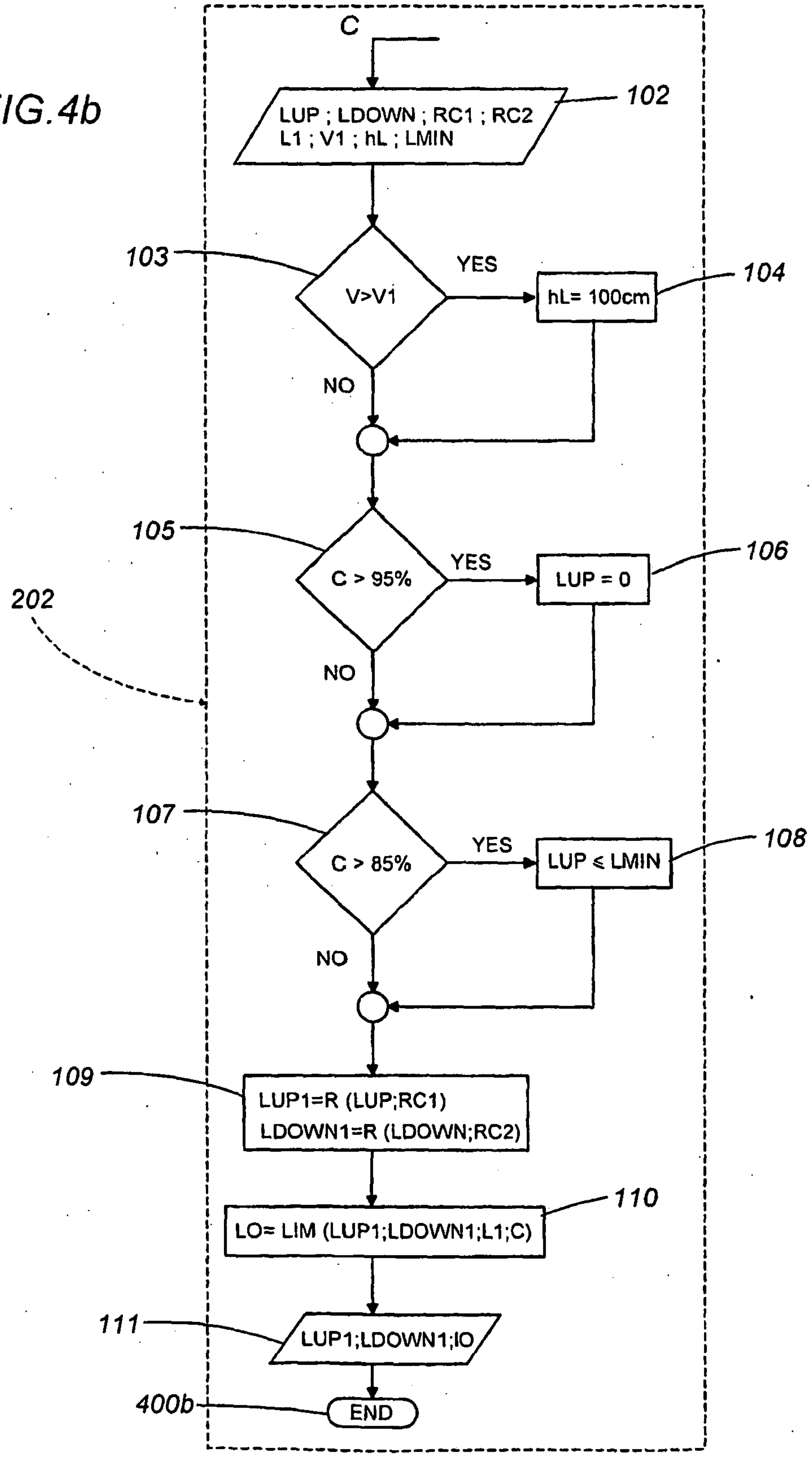

C
LUP ; LDOWN ; RC1 ; RC2
L1 ; V1 ; hL ; LMIN
102
103
V>V1
YES
hL= 100cm
104
NO
105
C > 95%
YES
LUP = 0
106
NO
202
107
C > 85%
YES
LUP ≤ LMIN
108
NO
109
LUP1=R (LUP;RC1)
LDOWN1=R (LDOWN;RC2)
110
LO= LIM (LUP1;LDOWN1;L1;C)
111
LUP1;LDOWN1;IO
400b
END

FIG.4c

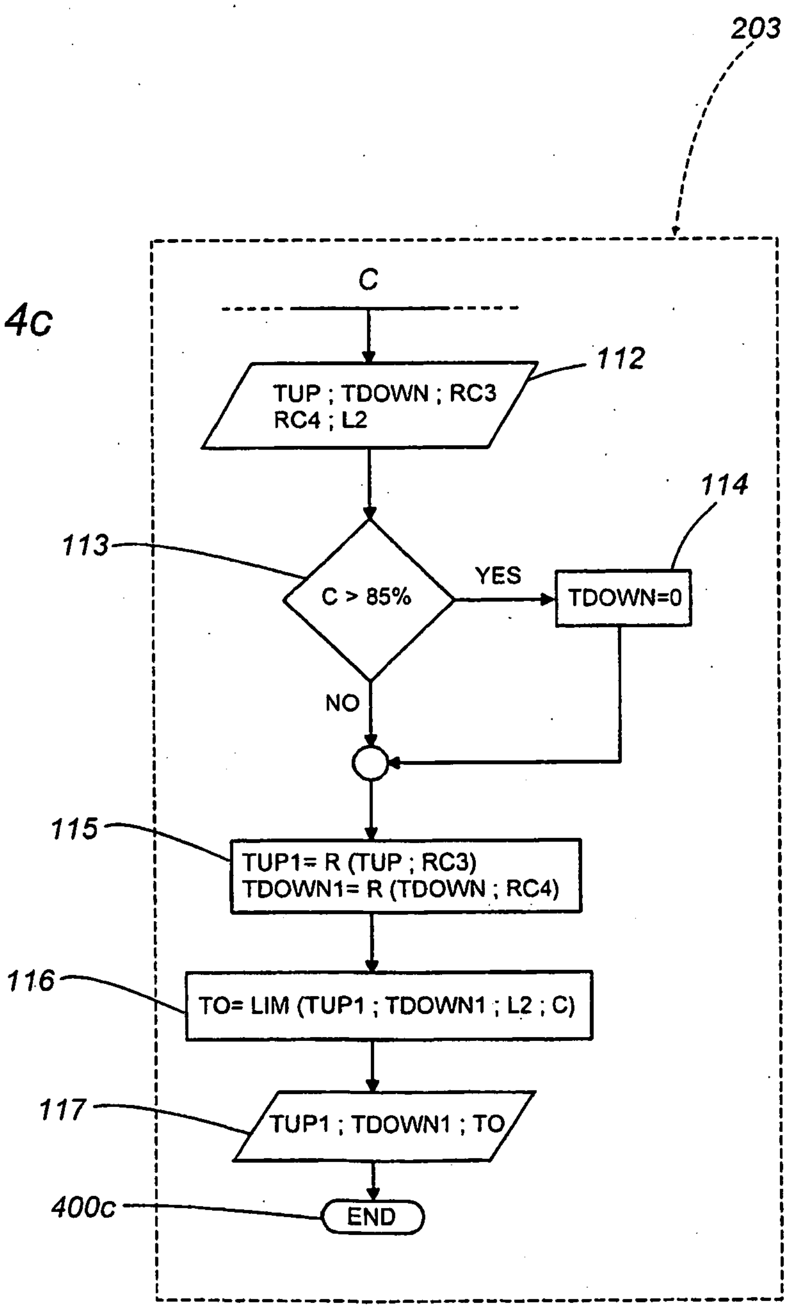

203
C
TUP ; TDOWN ; RC3
RC4 ; L2
112
113
C > 85%
YES
TDOWN=0
114
NO
115
TUP1= R (TUP ; RC3)
TDOWN1= R (TDOWN ; RC4)
116
TO= LIM (TUP1 ; TDOWN1 ; L2 ; C)
117
TUP1 ; TDOWN1 ; TO
400c
END

FIG.4d

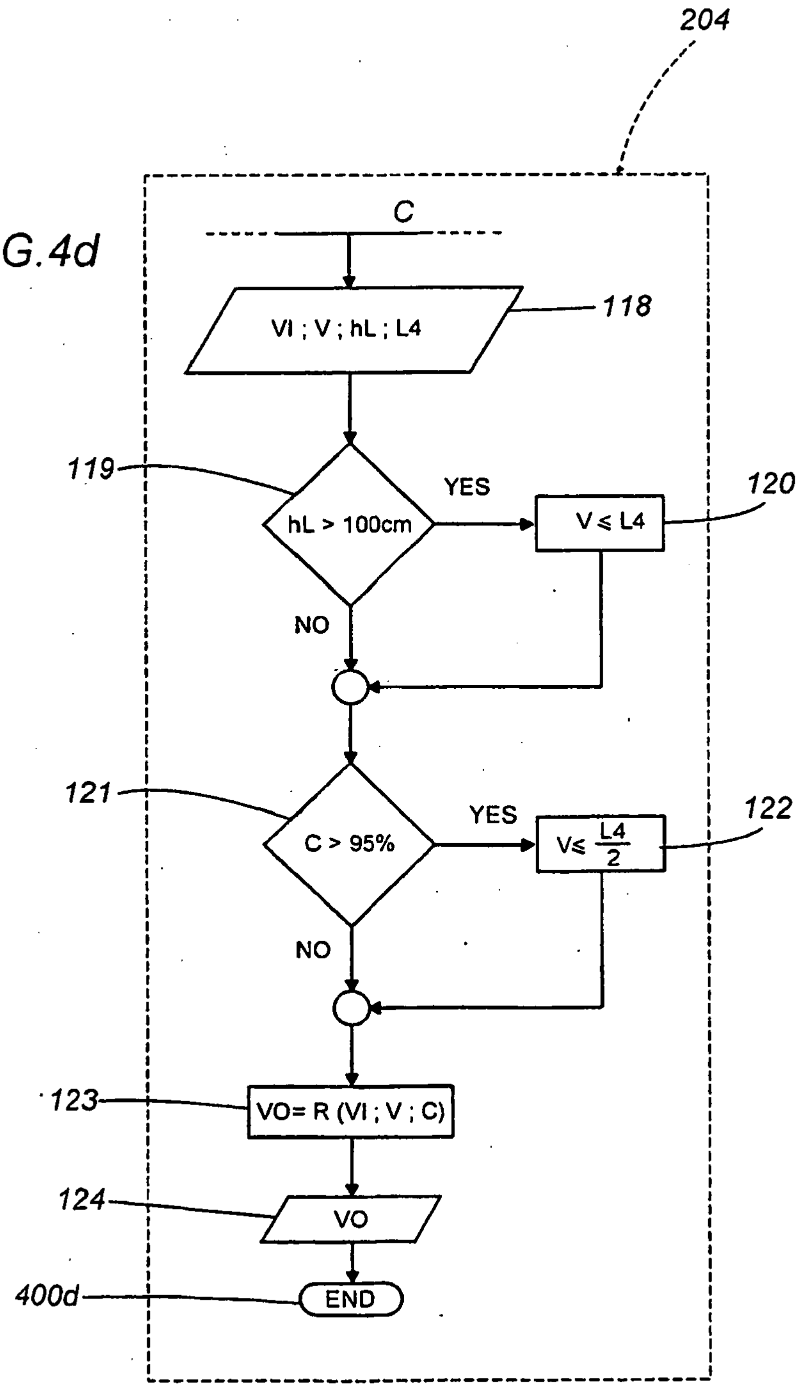
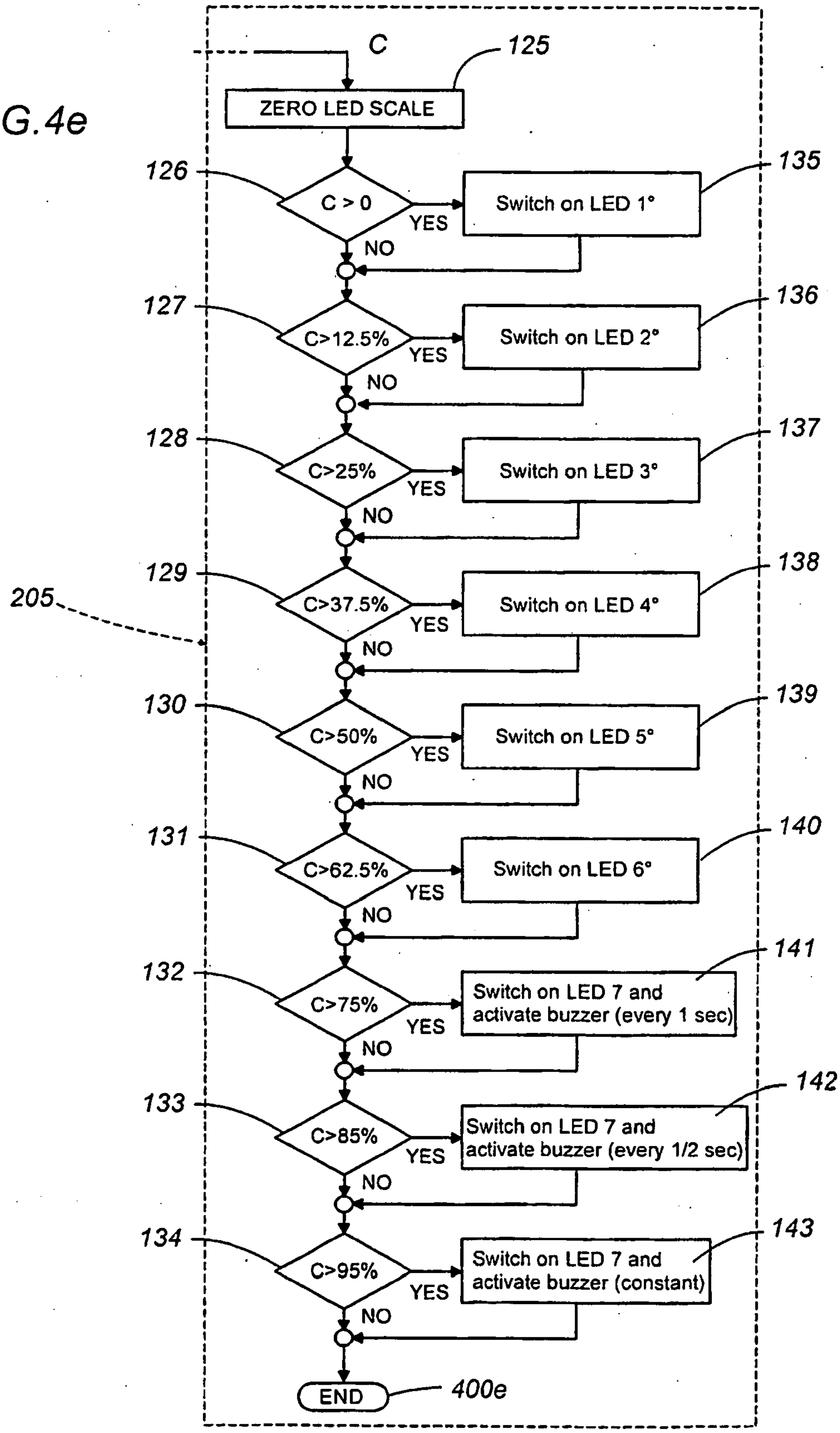

204
C
VI ; V ; hL ; L4
118
119
hL > 100cm
YES
V ≤ L4
120
NO
121
C > 95%
YES
V≤ L4/2
122
NO
123
VO= R (VI ; V ; C)
124
VO
400d
END

FIG.4e


C
125
ZERO LED SCALE
126
C > 0
YES
NO
Switch on LED 1°
135
127
C>12.5%
YES
NO
Switch on LED 2°
136
128
C>25%
YES
NO
Switch on LED 3°
137
129
C>37.5%
YES
NO
Switch on LED 4°
138
205
130
C>50%
YES
NO
Switch on LED 5°
139
131
C>62.5%
YES
NO
Switch on LED 6°
140
132
C>75%
YES
NO
Switch on LED 7 and activate buzzer (every 1 sec)
141
133
C>85%
YES
NO
Switch on LED 7 and activate buzzer (every 1/2 sec)
142
134
C>95%
YES
NO
Switch on LED 7 and activate buzzer (constant)
143
END
400e

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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