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(54) **Lifting device and method for controlling a lifting device**

(57) Method for controlling a lifting device (1) arranged to be lifted between a lifting state and a resting state, and to change between a holding position and a releasing position. The method comprises the steps, a) at least a state signal with information on the state of the lifting device is received, b) change of the state of a lifting device from the lifting state to the resting state is detected, c) at a detected change of the state of a lifting device

from the lifting state to the resting state, monitoring if the state of a lifting device is maintained in the resting state during a certain time period, d) if the state of a lifting device is maintained in the resting state during said time period, generating at least one control signal for achieving a change between the holding position and the releasing position, and otherwise maintain the lifting device in the holding position or the releasing position.

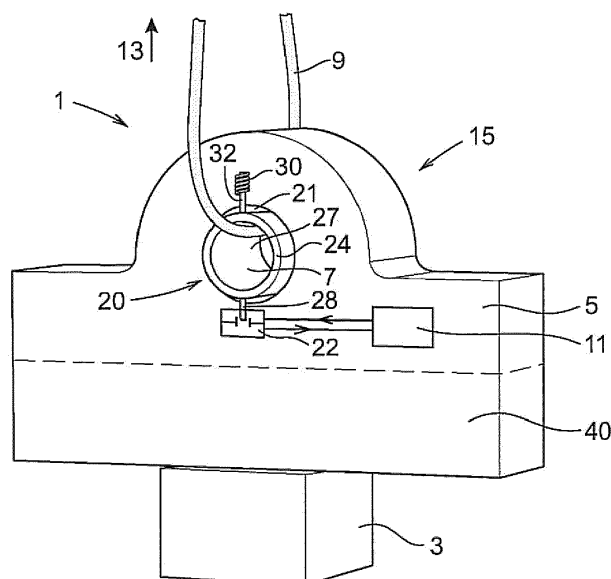


Fig. 1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a method for controlling a lifting device. The lifting device is arranged to be lifted between a lifting state and a resting state, and to change between a holding position and a releasing position. The present invention further relates to a control unit for controlling a lifting device and a lifting device comprising the control unit, and use of said control unit and lifting device.

PRIOR ART

[0002] Lifting devices are used for lifting and moving an object between different location on the ground or on a support. The lifting device comprises means for holding and releasing the object. By means of the means for holding and releasing the object, the object can be held at the lifting device and released from the lifting device. An operator controls the means for holding and releasing the object.

[0003] The lifting device is adapted to be connected to a lifting element that is connected to a lifting arrangement, such as a crane a traverse or similar. The lifting element is for example a lifting hook, a lifting strap or similar.

[0004] The lifting device is used for moving the object by means of that the object is held at the lifting device in a first position in contact with a first support. Thereafter the object is lifted and moved to a second position in contact with a second support, whereupon the object is released from the lifting device. For example, the lifting device is used in a storage, at an assembly line, etcetera.

[0005] A problem with lifting devices according to the state of the art is that an operator of the lifting device manually must control the means for holding and releasing the object. The means for holding and releasing the object is controlled for example by means of a control on the lifting device or a remotely operated control. Thereby, the operator must visually assure that the lifting device is in a resting state on the ground or on the support before holding and releasing of the object is controlled so that the object is released from the lifting device or the object is held at the lifting device. Thereby, the operator must be in the vicinity of the lifting device for observing if the lifting device is in the resting state. Even if an operator is in vicinity of the lifting device it may be difficult to see if the lifting device is in the lifting state or in the resting state due to that the lifting device or objects in the surrounding obstruct the vision of the operator.

[0006] A change between the holding position and the releasing position should be performed when the lifting is in a resting state on the object. In the case where the lifting device is an electro magnet or an electro permanent magnet, there is a risk that the operator lowers the lifting device without object with the lifting device in a holding position towards the object on the support. Thereby, a

displacement of the object can be created that displaces the object towards the lifting device, wherein the object and the lifting device can be damaged.

[0007] Another problem with lifting device according to the state of the art is that it is possible for the operator to control the means for holding and releasing the object so that the object is released from the lifting device prior to that the object is arranged on the intended support. For example, an operator can intentionally or by mistake release the object from the lifting device prior to that the object is arranged on the intended support.

[0008] In certain situation, the control for controlling the means for holding and releasing the object is located on the lifting device. A disadvantage is that the operator thereby must be in direct vicinity to the lifting device for controlling the holding and releasing of the object. Thereby, there is a risk that the object, at contact between the control and surrounding objects, is released from the lifting device.

[0009] If the object is released from the lifting device prior to that the object is in contact with the intended support, there is a risk that the operator or persons in the surrounding is injured. Furthermore there is a risk that the object is damaged or that damage arises on objects in the surrounding. Accordingly it is desirable to avoid that an object is released from the lifting device when the lifting device is in a lifting state.

SUMMARY OF THE INVENTION

[0010] The object of the present invention is to provide a method for controlling a lifting device that solves above mentioned problems of the prior art. A first object with the present invention is to provide a method for controlling a lifting device when the lifting device is used for lifting an object between different positions on a support without that an operator visually needs to assure that the lifting device is in a resting state on the support. A second object with the present invention is a method for controlling a lifting device without that an operator manually needs to control the change between the holding position and the releasing position. A third object with the present invention is a method for controlling a lifting device without that the operator directly can control the change between the holding position and the releasing position. A fourth object with the present invention is a method for controlling a lifting device so that a situation is prevented where the lifting device in the holding position without holding an object is changed from the lifting state to the resting state.

[0011] The object is obtained with a method according to claim 1 for controlling the previously mentioned lifting device. The method comprises the steps:

- receiving at least a state signal with information on the state of the lifting device,
- detecting a change of the lifting device from the lifting state to the resting state,
- at a detected change of the state of the lifting device

from the lifting state to the resting state, monitoring if the state of a lifting device is maintained in the resting state during a certain time period,

- if the state of the lifting device is maintained in the resting state during said time period, generating at least a control signal for achieving a change between the holding position and the releasing position, and otherwise maintain the lifting device in the holding position or the releasing position.

[0012] The method comprises detecting when the state of the lifting device is changed from the lifting state to the resting state. At a detected change of the state of the lifting device from the lifting state to the resting state, it is assured that the lifting device is in the resting state by means of that the state of the lifting device is monitored during the first mentioned time period. If the state of a lifting device during the time period is maintaining the resting state, the lifting device is assumed to be intentionally brought to the resting state with the purpose of either collecting or releasing an object.

[0013] After that the lifting device is maintained in the lifting state during the first mentioned time period, the first mentioned control signal is generated that achieves a change between the holding position and the releasing position.

[0014] The term "change" relates to a change of the position of the lifting device from the holding position to the releasing position or from the releasing position to the holding position.

[0015] The term "state" relates to whether the lifting device is in the lifting state or the resting state. In the lifting state the lifting device is affected by a lifting force in a direction away from the support. In the resting state the lifting device mainly lacks interaction from the lifting force.

[0016] The term "position" relates to whether the lifting device is in the holding position or the releasing position. In the holding position the lifting device is arranged so that an object can be held at the lifting device. In the releasing position the lifting device is arranged so that an object can not be held at the lifting device.

[0017] By means of the method the change between the holding position and the releasing position is controlled without that the operator manually needs to control the lifting device. Thereby, the use of the lifting device is facilitated since that the lifting device can be operated without control for controlling the holding position and the releasing position. Furthermore the use of the lifting device is facilitated by means of that the change between the holding position and the releasing position is possible without the necessity that the operator visually assures that the lifting device is in the resting state. Furthermore, the risk that the object intentionally or by mistake is released from the lifting device prior to that the lifting device is in the resting state on the ground is reduced.

[0018] According to an embodiment of the invention, the method comprises the steps:

- subsequent to generating the first mentioned control signal, monitoring if the state of the lifting device is changed from the resting state to the lifting state during a second certain time period,
- If the state of the lifting device is changed from the resting state to the lifting state during said second time period, maintain the lifting device in the holding position or in the releasing position, and otherwise generate at least a second control signal for achieving a change between the holding position and the releasing position.

[0019] After that the first mentioned control signal has been generated, the state of the lifting device is either changed from the holding position to the releasing position or from the releasing position to the holding position. Thereby, holding of the object or releasing of the object has been induced. If the control of the lifting device has occurred according to a wish of the operator, the lifting device is to be removed from the support.

[0020] The method comprises monitoring if a state of a lifting device is changed from the resting state to the lifting state within the second time period. At a change from the resting state to the lifting state within the second time period, it is assumed that prior change of the position of the lifting device between the holding position and the releasing position was correct and that the lifting device is maintained in the holding or the releasing position that was generated by the first mentioned control signal.

[0021] If, on the other hand, the state of the lifting device has not been changed from the resting state to the lifting state within the second time period, it is assumed that the prior change of the position of a lifting device between the holding and the releasing position was incorrect and that a second control signal is generated that achieves a change between the holding position and the releasing position.

[0022] The method results in that the operator has within the second time period to confirm that the change between the first mentioned control signal is correct by means of controlling the lifting arrangement so that the state of the lifting device is changed from the resting state to the lifting state.

[0023] If the change of the first mentioned control signal is incorrect, the operator refuses the change by means of maintaining the lifting device in the resting state on the support, wherein the second control signal generates a change between the holding position and the releasing position subsequently to the second time period. Accordingly, the change of the first mentioned control signal is restored by means of generating the second control signal.

[0024] According to an embodiment of the invention, the method comprises the steps:

- subsequent to generating the second control signal that achieves a change from the holding position to the releasing position, maintaining the lifting device

in the holding position or the releasing position and monitoring of change in the state of the lifting device from the resting state to the lifting state,

- at a detected change of the state of the lifting device from the resting state to the lifting state during a time that exceeds a third time period, generating a third control signal that results in that changes between the holding position and the releasing position again are permitted according to the method.

[0025] Subsequent to generating the second control signal that results in the change of the position between the holding position and the releasing position, the lifting device is maintained in its position. Thereby, no further change of the position of the lifting device occurs while the lifting device is located in the resting state.

[0026] The method comprises monitoring a change in the state of the lifting device from the resting state to the lifting state. At a detected change of the state of the lifting device from the resting state to the lifting state during a time that exceeds the third time period, generating a third control signal that results in that changes between the holding position and the releasing position again are permitted.

[0027] By means of changing the state of the lifting device from the resting state to the lifting state during a time that exceeds the first time period, possible changes to the means for holding and releasing the object is restarted according to the previous method steps.

[0028] According to an embodiment of the invention, the method comprises the steps:

- during a fourth certain time period for generating the first mentioned control signal, generating a first restriction signal that results in that the lifting device is maintained in the resting state.

[0029] During the fourth time period a change is intended between the holding position and the releasing position. By means of the method the first restriction signal is generated that prevents changes in the state of a lifting device from the resting to the lifting state. Thereby, it is prevented that the object by mistake is dropped by means of that the state of the lifting device is changed from the lifting state at the same time that the change between the holding position and the releasing position is generated by the first mentioned control signal.

[0030] According to an embodiment of the invention, the fourth time period is between the first mentioned time period and the second time period.

[0031] According to an embodiment of the invention, the first restriction signal that prevents the state of the lifting device from being changed ceases after the end of the fourth time period.

[0032] According to an embodiment of the invention, the first restriction signal is generated if the state of a lifting device is maintained in the resting state during the first mentioned time period, and otherwise the first re-

striction signal is not generated.

[0033] According to an embodiment of the invention the method comprises four steps:

- 5 - during a fifth certain time period for generating said second control signal, generating a second restriction signal that results in that the lifting device is maintained in resting state.

10 **[0034]** During the fifth time period a change between the holding position and the releasing position is intended. By means of the method, the second restriction signal is generated that prevents changes in the state of the lifting device from the resting to the lifting state.

15 **[0035]** Thereby, it is prevented that the object by mistake is dropped by means of that the state of the lifting device is changed to the lifting state at the same time that a change between the holding position and the releasing position is generated by the second control signal.

20 **[0036]** According to an embodiment of the invention, the fifth time period is subsequent to the second time period and prior to the third time period.

25 **[0037]** According to an embodiment of the invention, the second restriction signal that prevents the state of the lifting device from being changed ceases after the end of the fifth time periods.

30 **[0038]** According to an embodiment of the invention, the second restriction signal is generated if the state of a lifting device is maintained in the resting state during the second time period, and otherwise the second restriction signal is not generated.

35 **[0039]** According to an embodiment of the invention, the lifting device is arranged so that the lifting state is either in the holding position while holding the object or in the releasing position without the object.

40 **[0040]** Thereby, a situation is prevented where the lifting device is the holding position without holding an object and the lifting device is changed from the lifting state to the releasing position.

[0041] According to an embodiment of the invention the first mentioned time period is between 0,5 to 5 seconds, preferably between 1 and 3 seconds.

45 **[0042]** According to an embodiment of the invention the second time period is between 10 to 20 seconds, preferably between 12 to 17 seconds.

[0043] According to an embodiment of the invention the third time period is between 0,5 to 5 seconds, preferably between 1 to 3 seconds.

50 **[0044]** According to an embodiment of the invention the fourth time period is between 0,5 to 10 seconds preferably between 2 to 5 seconds.

[0045] According to an embodiment of the invention the fifth time period is between 0,5 to 10 seconds, preferably between 2 to 5 seconds.

55 **[0046]** The object with the present invention is also achieved by a control unit for controlling a lifting device. The control unit comprises:

- means for receiving information whether the lifting device is in a lifting state or a resting state,
- means for generating at least a control signal for achieving a change between a holding position and a releasing position,
- a clock unit adapted to determine at least one time period, wherein the control unit is characterized in that the control unit is adapted to control the holding and releasing of the object by means of the method according to any of the claims 1 to 7.

[0047] The means for receiving the information whether the lifting device is in a lifting state or a resting state is adapted to receive information from the means for detecting whether the lifting device is in a lifting state or a resting state. Based on the information on the state of the lifting device and the time from changes in the state of the lifting device, changes in the state of the lifting device is controlled by means of the means for generating at least a control signal.

[0048] According to an embodiment of the invention the control unit comprises means for controlling a lifting arrangement so that the lifting device is maintained in the resting state.

[0049] By means of the means for controlling a lifting arrangement, the control unit has the ability to prevent changes in the state of the lifting device from the resting state to the lifting state at a change between the holding position and the releasing position. Thereby, dropping of the object by mistake is avoided.

[0050] According to an embodiment of the invention, the means for controlling the lifting arrangement is adapted to generate a restriction signal that is transmitted to the lifting arrangement, which restriction signal prevents changes in the state of the lifting device.

[0051] The object with the present invention is also obtained with a lifting device for lifting an object, wherein the lifting device comprises

- means for holding and releasing of an object,
- means for detecting whether the lifting device is in a lifting state or a resting state. The lifting device is characterized in that the lifting device comprises a control unit according to any of claims 8 to 9.

[0052] According to an embodiment of the invention, the lifting device comprises a body with a space adapted to receive a lifting element, wherein the lifting element is adapted to act on the lifting device with a force so that the lifting device with possible object is lifted from a support, wherein the means for detecting whether the lifting device is in a lifting state or a resting state comprises

- a displaceable part arranged within the space of the lifting device, which displaceable part comprises a in relation to the space displaceable contact member with a contact surface, wherein the contact surface is adapted to be brought into contact with the lifting

element and to receive a certain force from the lifting element so that the displaceable part is displaced from a first position to a second position, wherein the displaceable part is adapted to at ceasing of said force be displaced from the second position to the first position,

- indication means adapted to detect a position of the displaceable part and to generate at least a state signal that indicates whether the lifting device is in a lifting state or a resting state based on the detected position.

[0053] The position of a displaceable part indicates whether the lifting device is in the lifting state or the resting state. When the displaceable part is located in the first position the lifting device is in the resting state. When the displaceable part is located in the second position the lifting device is in the lifting state.

[0054] The indicating means is adapted to detect which of the first and the second position the displaceable part is located in. Based on the position of the displaceable part, the indicating means generate said state signal that indicates the state.

[0055] According to an embodiment of the invention, the contact member is ring formed with an opening adapted to receive the lifting element.

[0056] According to an embodiment of the invention, the indicating means comprises a switch adapted to in one of the first and the second position turn on the switch and in the other of the first and the second position turn off the switch, wherein the displaceable part comprises a first protruding member adapted to act on the switch.

[0057] The switch is switched between actuated state and deactivated state by means of interaction from the protruding member. The switch is switched between activated and deactivated state when the displaceable part is displaced between the first and the second position.

[0058] According to an embodiment of the invention, the lifting device comprises a re-displacing means adapted to act on the displaceable part so that the displaceable part is re-displaced from the second position to the first position at ceasing of said force from the lifting element.

[0059] By means of the re-displacing means it is assured that the displaceable part is re-displaced from the second position to the first position at ceasing of said force from the lifting element.

[0060] According to an embodiment of the invention, the displaceable part comprises a second protruding member, the second protruding member is connected to the re-displacing means, wherein the second protruding member and the re-displacing means are adapted to cooperate in re-displacing the displaceable part.

[0061] According to an embodiment of the invention, the re-displacing means comprises an elastic element arranged to act on the displaceable part with a re-displacing force.

[0062] The re-displacing force from the elastic element exceeds possible friction forces that prevent the re-dis-

placing of the displaceable part from the second position to the first position at lack of force from the lifting element. The elastic element is for example a spiral spring a pneumatic spring, an elastic part, etcetera.

[0063] According to an embodiment of the invention, the first protruding member and the second protruding member protrudes in different direction from the contact member.

[0064] According to an embodiment of the invention, the means for holding and releasing the object is an electro permanent magnet.

[0065] Electro permanent magnets require only energy when it is turned on and off. Thereby, the energy consumption is low in comparison to an electro magnet. Furthermore, the use of electro permanent magnet in lifting device has the advantage that the lifting device maintains its magnetic properties also at a power failure. Accordingly, the object will be maintained at the lifting device even in the event of a power failure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0066] The invention will now be explained in detail by describing different embodiments of the invention and with reference to the appended figures.

Figure 1 discloses an embodiment of a lifting device for holding and releasing an object according to the invention.

Figure 2a discloses a part of a lifting device in an enlarged view where the displaceable part is located in the second position.

Figure 2b discloses the lifting device in figure 2a where the displaceable part is located in the first position.

Figure 3 discloses a flow chart of an embodiment of the method for controlling a lifting device.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

[0067] Figure 1 discloses an embodiment of a lifting device 1 for holding and releasing an object 3 according to the invention. The lifting device 1 comprises a body 5 with a space 7. In the disclosed embodiment the space 7 has the form of a through circular hole. The space 7 can also have other forms.

[0068] The space 7 is adapted to receive a lifting element 9, such as a lifting hook, a lifting strap, or similar, so that the lifting device 1 and lifting element 9 cooperate with each other in lifting the lifting device 1 and possible object 3.

[0069] The lifting device 1 comprises means 40 for controllably holding and releasing the object 3, such as an electro magnet, gripping arm, a vacuum grip, etcetera.

In the disclosed embodiment, the lifting device comprises an electro magnet.

[0070] A control unit 11 is connected to the means 40 for holding and releasing an object 3, wherein the control unit 11 controls the holding and releasing of the object 3. In the disclosed embodiment, the control unit 11 controls activation and deactivation of the electro magnet, wherein the holding and releasing of the object 3 is controllable. The control unit comprises necessary electronics for controlling the means 40, for example a micro processor or similar electronic circuits.

[0071] The control unit comprises also a clock unit adapted to measure and register time from a change in the state of the lifting device.

[0072] The lifting element 9 is connected to a lifting arrangement, such as a crane, traverse or similar (not disclosed in figure 1). The lifting arrangement acts on the lifting element 9 with a force in a lifting direction 13, wherein the lifting device 1 is lifted in the lifting direction 13. Thereby the lifting device 1 is adapted to be lifted and displaced between different locations.

[0073] The lifting device 1 further comprises a device 15 for preventing releasing of an object 3 prior to that the object has reached contact with the support. The device 15 comprises a displaceable part 20, an indication means 22 and a control unit 11.

[0074] The displaceable part 20 is located in the space 7. The displaceable part 20 is displaceable between a first position and a second position. The displaceable part 20 is separated from the space 7 by a gap 21, which allows displacement of a displaceable part 20 between the first and the second position.

[0075] Figure 2a discloses a part of the lifting device in an enlarged view where the displaceable part 20 is located in the second position. The lifting element 9 acts on the displaceable part 20 with a force in the lifting direction 13. When the displaceable part is located in the second position, the lifting device is in the lifting state.

[0076] Figure 2b discloses the lifting device in Fig. 2a where the displaceable part is located in the first position. The displaceable part 20 lacks interaction from the lifting element 9. When the displaceable part is located in the first position the lifting device is in a resting state.

[0077] The displaceable part 20 is adapted be displaced in the lifting direction 13 from the first position to the second position when the lifting element 9 acts on the displaceable part 20 with a certain force.

[0078] The displaceable part 20 is adapted to be displaced reverse to the lifting direction 13 from the second position to the first position when the force from the lifting element 9 on the displaceable part 20 ceases.

[0079] The indication means 22 is adapted to detect the first and the second position of the displaceable part 20. The indicating means 22 is adapted to generate and transmit at least one state signal to the control unit 11 that indicates if the displaceable part 20 is in the first or the second position.

[0080] In an alternative embodiment, the indication

means 22 generates a state signal for each of the first position and the second position. For example, a state signal with 0 V indicates that the displaceable part 20 is in the first position, wherein a state signal with +5 V indicates that the displaceable part 20 is in the second position.

[0081] The displaceable part 20 comprises a contact member 24 and a contact surface 26. The contact member 24 has an opening 27 that is adapted to receive the lifting element 9. The contact surface 26 is directed away from the lifting direction 13. Thereby, the contact surface 26 is adapted to be brought into contact with the lifting element 9 and to abut each other.

[0082] The contact member 24 is in the disclosed embodiment a ring enclosed along the circumference of the space 7. The contact surface 26 is accordingly the part of the inner envelope surface of the ring that is directed away from the lifting direction 13.

[0083] The displaceable part 20 comprises a first protruding member 28, which protrudes from the contact member 24. The first protruding member 28 is adapted to be displaced at a displacement of the displaceable part 20 between the first and the second position, wherein the first protruding member 28 is adapted to act on the indication means 22 so that at least a state signal is generated.

[0084] In the disclosed embodiment of the invention, the indication means 22 contains a switch, such as a micro switch, an optical switch, a relay, etcetera. In an embodiment, the switch is arranged to disconnect the connection when the protruding member 28 is in the first position and to establish the connection when the first protruding member 28 is in the second position. In an alternative embodiment, the switch is arranged to disconnect the connection when the first protruding member 28 is in the second position and to establish the connection when the first protruding member 28 is in the first position.

[0085] The displaceable part 20 comprises a re-displacing means 30 adapted to re-displace the displaceable part 20 from the second position to the first position when the force from the lifting element 9 ceases.

[0086] The displaceable part 20 comprises a second protruding member 32, which protrudes from the contact member 24. The second protruding member 32 is adapted to be displaced at a displacement of a displaceable part 20 between the first and the second position, wherein the second protruding member 32 is adapted to be influenced by the re-displacing means 30.

[0087] The first protruding member 28 protrudes in a direction reverse to the lifting direction 13. The second protruding member 32 protrudes in a direction along the lifting direction 13.

[0088] In the disclosed embodiment of the invention, the re-displacing means 30 comprises an elastic element, such as a spiral spring, a pneumatic spring, an elastic part, etcetera. The elastic element is adapted to act on the second protruding member 32 with a re-dis-

placing force directed away from the lifting direction 13. Thereby, it is assured that the displaceable part 20 is re-displaced from the first position to the second position at lack of force from the lifting element 9. The re-displacing force from the elastic element is arranged to exceed possible friction forces that counteracts to the re-displacing of the displaceable part 20 from the first position to the second position at lack of force from the lifting element 9.

[0089] The control unit 11 is arranged to receive a state signal from the indication means 22. Thereby, the control unit 11 receives information on whether the lifting device 1 is in the lifting or the resting state.

[0090] The control unit 11 is arranged to prevent releasing the object 3 from the lifting device 1 when the displaceable part 20 is located in the second position. The control unit 11 is arranged to allow releasing of the object 3 from the lifting device 1 when the displaceable part 20 is located in the first position.

[0091] The contact member 24 can be arranged in a various different forms which allow the contact member 24 to be received by the space 7 in the lifting device 1 and which forms allows a contact between the contact member 24 and the lifting element 9. For example, the contact member 24 comprises a section of a ring, a flat part, a T-form part, etcetera.

[0092] The displaceable part 20 can further be adapted to, in the second position, create a mechanical locking that prevents releasing the object 3 from the lifting device 1, and in the first position releasing said mechanical locking so that releasing the object 3 from the lifting device 1 is allowed. The mechanical locking occurs independent on if the indication means 22 and the control system 11 is present or not. By means of the mechanical locking of a displaceable part 20, an automatic locking occurs that prevents releasing of the object. Thereby, the mechanical locking formed by the displaceable part 20 replaces possible manual mechanical locking. Such manual mechanical locking occurs for example on manual controlled lifting devices according to the state of the art.

[0093] Indicating means 22 and the re-displacing means 30 can both be connected to either of the first protruding member 28 or the second protruding member 32.

[0094] Figure 3 discloses a flow chart of an embodiment of the method for controlling the lifting device. Figure 3 is arranged with a time axes for indicating when an event in the method occurs in relation to the time.

[0095] The control unit 11 is adapted to receive information on the state and position of the lifting device, and information on the time from events during controlling the lifting device 1.

[0096] The method is initiated at "START" by means of that a state signal with information on the state of the lifting device is received. Thereby, monitoring of the state of the lifting device is possible.

[0097] At a detected change of the state of a lifting device 1 from the lifting state to the resting state, monitoring of the state of the lifting device is initiated with the

purpose of assuring that the state of a lifting device 1 is not changed from the resting state to the lifting state during a first time period t1.

[0098] If the state of a lifting device is not changed from the resting state to the lifting state during the first time period t1, a first control signal is generated that results in a change between the holding position and the releasing position.

[0099] On the other hand, if the state of a lifting device 1 is changed from the resting state to the lifting state during the first time period t1, the position of the lifting device is maintained. Thereafter, no change of the position of the lifting device occurs before the lifting device 1 again changes from the lifting state to the resting state.

[0100] During a fourth time period t4 immediately after the first time period t1, a first restriction signal is generated that prevents the state of the lifting device 1 from changing from the resting state to the lifting state. For example, the first restriction signal is transmitted to a lifting arrangement, which results in that the lifting arrangement is prevented from lifting the lifting device 1. The fourth time period t4 is intended for changes in the position of the lifting device 1. Thereby, a simultaneous change of the position and state of the lifting device is prevented. After the end of the fourth time period, the restriction signal ceases that prevents the position of the lifting device 1 to be changed.

[0101] After that the first control signal resulted in the change of the position of the lifting device 1, the position of the lifting device 1 is maintained and monitoring of changes in the state of the lifting device is initiated after the end of the fourth time period. The monitoring occurs during a second time period t2.

[0102] If the state of the lifting device 1 is changed from the resting state to the lifting state during the second time period t2, the position of the lifting device is maintained. Thereby, the lifting device 1 can be moved with an object to another position for releasing the object or moved without the object to another position for collecting an object. If the state of the lifting device again changes from the lifting state to the resting state, the method is restarted from monitoring the state of the lifting device during the first time period t1.

[0103] By means of changing the state of a lifting device from the resting state to the lifting state during the second time period t2, the change of the state position of the lifting device that was executed during the fourth time period t4 is confirmed.

[0104] If the state of the lifting device is not changed from the resting state to the lifting state during the second time period t2, a second control signal is generated that results in a change between the holding position and the releasing position.

[0105] By means of preventing change of the state of the lifting device 1 from the resting state to the lifting state during the second time period t2, the change of the position of the lifting device that was executed during the fourth time period t4 is rejected. The change that was

executed during the fourth time period t4 is restored by generating the second control signal that changes the state of the lifting device 1 back to the position that the lifting device 1 had before the fourth time period t4.

[0106] During a fifth time period t5 immediately after the second time period t2, a second control signal is generated that prevents the state of the lifting device from changing from the resting state to the lifting state. For example, the first restriction signal is sent to the lifting device, which results in that the lifting arrangement is prevented from lifting the lifting device 1.

[0107] The fifth time period t5 is intended for changing of the state of the lifting device 1. Thereby, a simultaneous change of the position and state is prevented. After the fifth time period t5, the restriction signal ceases that prevents the state of the lifting device from being changed.

[0108] After the fifth time period t5, changes in the lifting device is blocked and the state of the lifting device is monitored. If the state of the lifting device 1 is changed from the resting state to the lifting state during a time that exceeds the third time period t3, the third control signal is generated that results in that changes again are permitted. If the state of the lifting device 1 again is changed from the lifting state to the resting state the method is restarted from monitoring the state of the lifting device during the first time period t1.

[0109] By means of the method for controlling the lifting device, the control of the lifting device is automatized. Thereby, no control for controlling the change between the holding position and the releasing position is necessary. The change between the holding position and the releasing position is controlled according to the method on basis of changes in the state of the lifting device and the time from specific changes in the state of the lifting device.

[0110] The invention is not limited to the disclosed embodiments but may be modified and varied within the frame work of the claims.

Claims

1. Method for controlling a lifting device (1) arranged to be lifted between a lifting state and a resting state, and to change between a holding position and a releasing position, wherein the method comprises the steps:

- receiving a least one state signal with information on the state of the lifting device,
- detecting a change in the state of the lifting device from the lifting state to the resting state,
- at a detected change in the state of the lifting device (1) from the lifting state to the resting state, monitoring if the state of the lifting device (1) is maintained in the resting state during a certain time period (t1),

- if the state of the lifting device (1) is maintained in the resting state during said time period (t1), generating at least one control signal for achieving a change between the holding position and the releasing position, and otherwise maintain the lifting device (1) in the holding position or the releasing position. 5
2. Method according to claim 1, wherein the method further comprises the steps of: 10
- after generating the first mentioned control signal, monitoring if the state of the lifting device (1) is changed from the resting state to the lifting state during a second certain time period (t2), 15
- if the state of the lifting device (1) is changed from the resting state to the lifting state during said second time period (t2), maintaining the lifting device (1) in the holding position or the releasing position, and otherwise generating at least one second control signal for achieving a change between the holding position and the releasing position. 20
3. Method according to claim 2, wherein the method comprises the steps of: 25
- after generating the second control signal (t2) that achieves a change between the holding position and the releasing position, maintaining the lifting device (1) in the releasing position or the holding position and a change of the state of a lifting device (1) from the resting state to the lifting state is monitored, 30
- at a detected change in the state of a lifting device (1) from the resting state to the lifting state during a time that exceeds a third time period (t3), generating a third control signal that results in that changes again is permitted between the holding position and the releasing position according to the method. 40
4. Method according to any of the previous claims, wherein the method further comprises the steps of: 45
- during a fourth certain time period (t4) for generating the first mentioned control signal, generating a first restriction signal that results in that the lifting device (1) is maintained in the resting state. 50
5. Method according to claim 4, wherein the fourth time period (t4) is between the first mentioned time period (t1) and the second time period (t2). 55
6. Method according to any of the previous claims, wherein the method further comprises the steps of:
- during a fifth certain time period (t5) for generating said second control signal, generating a second restriction signal that results in that the lifting device (1) is maintained in the resting state.
7. Method according to claim 6, wherein the fifth time period (t5) is subsequent to the second time period (t2) and prior to the third time period (t3).
8. A control unit (11) for controlling a lifting device (1), wherein the control unit (11) comprises
- means for receiving information on whether the lifting device (1) is in a lifting state or a resting state,
- means for generating at least one control signal for achieving a change between a holding position and a releasing position,
- a clock unit adapted to determine at least one time period, **characterized in that** the control unit (11) is adapted to control the holding and releasing of the object by means of the method according to any of the claims 1-7.
9. A control unit (11) according to claim 8, wherein the control unit (11) comprises means for interacting with a lifting arrangement so that the lifting device (1) is maintained in the resting state.
10. use of a control unit (11) according to any of claims 8-9.
11. Lifting device (1) for lifting an object, wherein the lifting device (1) comprises
- means (40) for holding and releasing an object,
- means (15) for detecting whether the lifting device (1) is in a lifting state or a resting state,
- characterized in that** the lifting device (1) comprises a control unit (11) according to any of claims 8-9.
12. A lifting device (1) according to claim (11) comprising a body (5) with a space (7) adapted to receive a lifting element (9), wherein the lifting element (9) is arranged to influence the lifting device (1) with a force so that the lifting device (1) with possible object (3) is lifted from a support, wherein the means (15) for detecting whether the lifting device (1) is in a lifting state or a resting state comprises
- a displaceable part (20) arranged in the space (7) of the lifting device (1), which displaceable part (20) comprises a movable contact member (24) displaceable in relation to the space (7) with a contact surface (26), wherein the contact surface (26) is adapted to be brought into contact

with a lifting element (9) and receive a certain force from the lifting element (9) so that the displaceable part (20) is displaced from a first position to a second position, wherein the displaceable part (20) is adapted to at cease of said force be displaced from the second position to the first position, 5

- indicating means (22) adapted to detect the position of the displaceable part (20) and to induce at least a state signal that indicates whether the lifting device (1) is in a lifting state or a resting state based on the detected position. 10

13. A lifting device (1) according to any of claims 11-12, wherein the means (15) for detecting whether the lifting device (1) is in a lifting state or a resting state comprises at least one re-displacing means (30) adapted to act on the displaceable part (20) so that the displaceable part (20) is re-displaced from the second position to the first position at cease of said force from the lifting element (9). 15 20

14. Lifting device (1) according to any of claims 11- 13, **characterized in that** the means (40) for holding and releasing the object (3) comprises an electro permanent magnet. 25

15. Use of a lifting device (1) according to any of claims 11-14. 30

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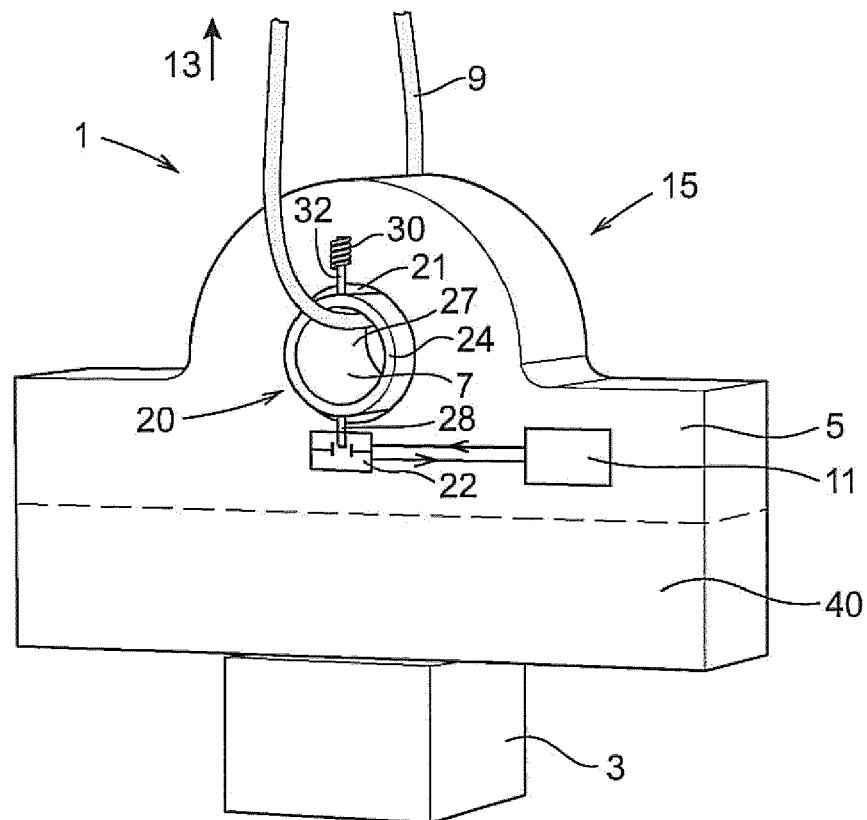


Fig. 1

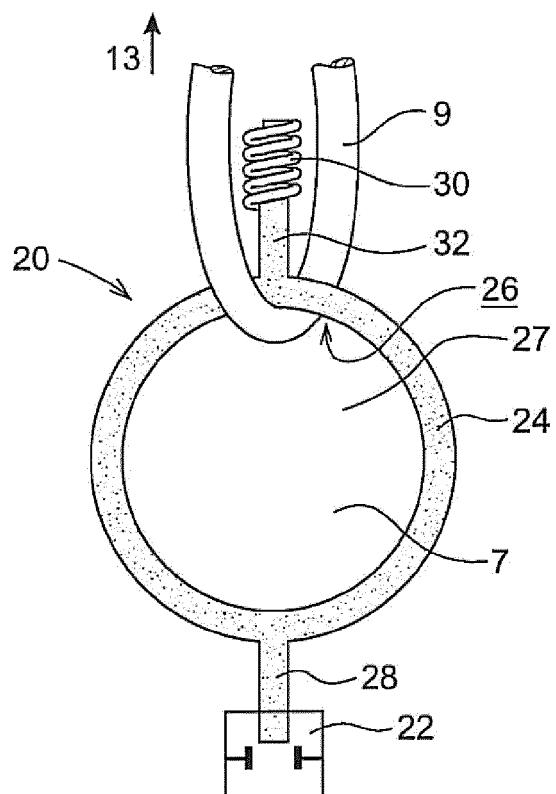


Fig 2a

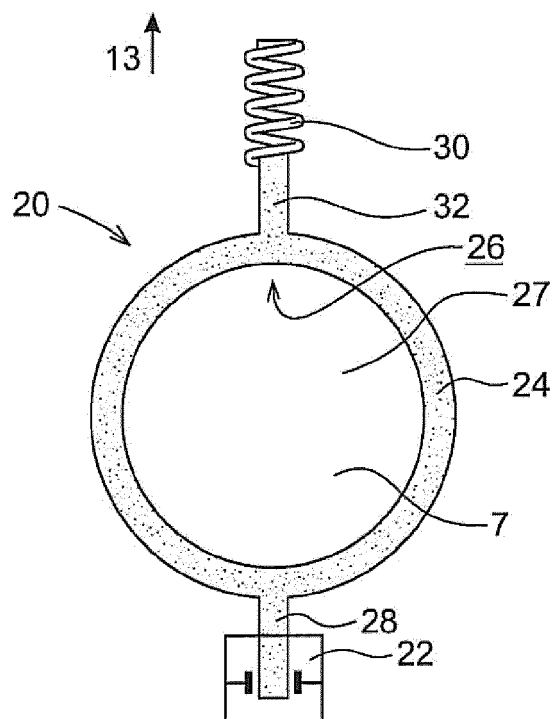


Fig 2b

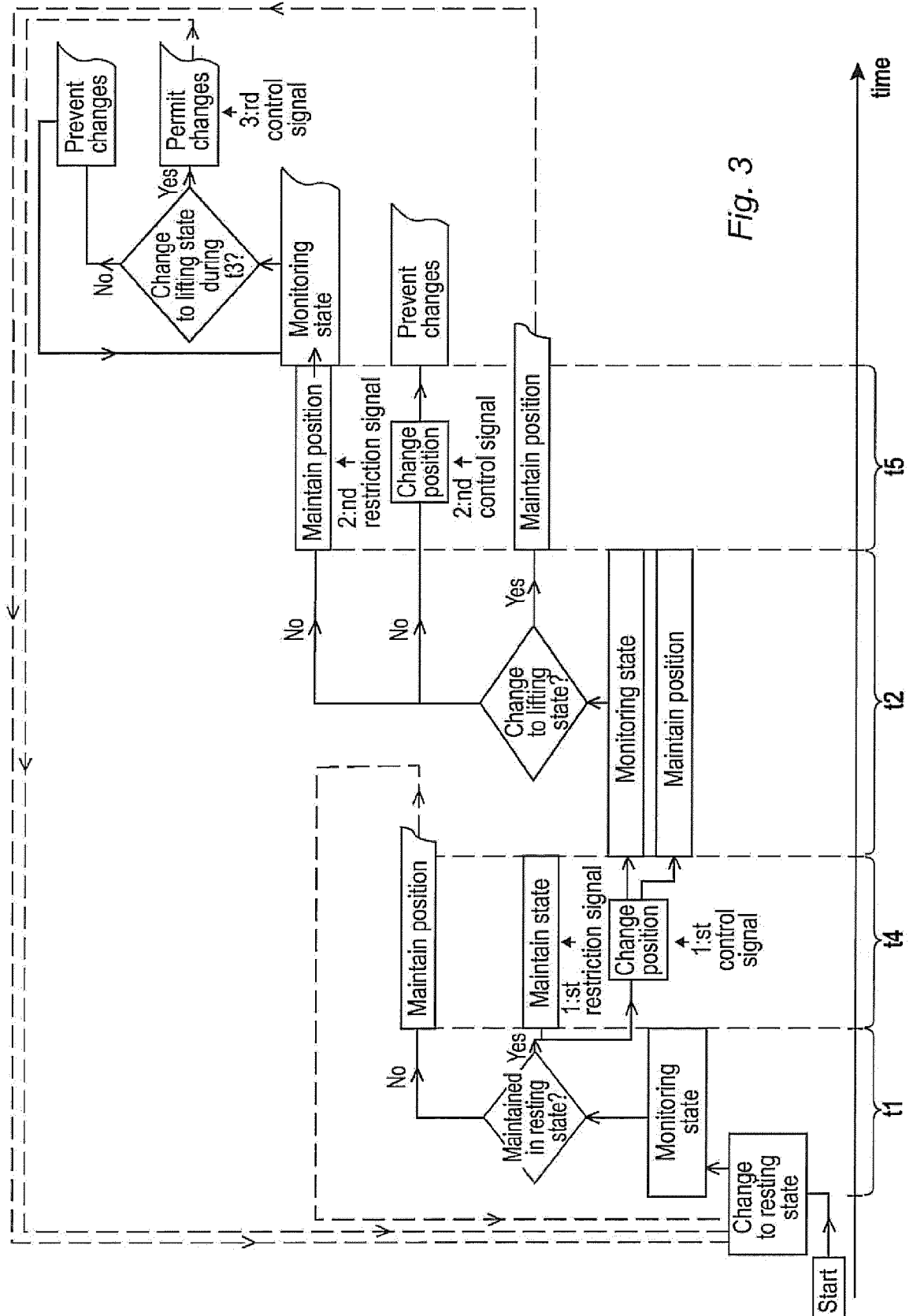


Fig. 3



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Application Number
EP 11 18 4394

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