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(54) INDUSTRIAL TRUCK CAPABLE OF RECOGNIZING A MATERIAL HANDLING APPARATUS

(57) An industrial truck includes: a frame (11), a mast (12) mounted on the frame in a rotatable manner around a substantially horizontal axis, a lifting element (13) configured to slide along the mast (12), said lifting element (13) being configured to support a plurality of material handling apparatuses (21, 21a) of different types, wherein each material handling apparatuses can be mounted on the lifting element in a releasable manner; tilting means configured to tilt the mast (12); lifting means configured to lift the lifting element (13) along the mast (12); a control unit (40) configured to control the movement of the tilting means and of the lifting means under instructions inputted by an operator of the industrial truck. The industrial truck (10) further includes means for acquiring information related to the material handling apparatus mounted or being currently mounted on the lifting element; wherein the control unit is configured to set one or more operational parameters of the industrial truck depending on the information related to the material handling apparatus acquired by the means for acquiring, the control unit (40) being configured to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters. (Fig. 1)

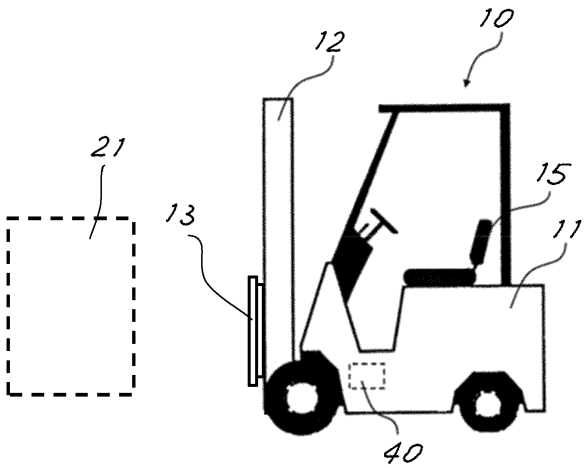

Fig. 1

EP 4 119 491 A1

Description

TECHNICAL FIELD OF THE INVENTION

[0001] The field of the present invention concerns an industrial truck, such as a forklift truck, capable of recognizing a material handling apparatus mounted on the industrial truck.

BACKGROUND OF THE INVENTION

[0002] Industrial trucks, such as forklift trucks, are known in the art. Conventionally, forklift trucks include a chassis, a mast pivotally mounted on the chassis and a fork (or another material handling apparatus) slidably mounted on the mast. Conventionally, the fork is mounted on a fork-carrying plate of a lifting assembly of the industrial truck, the plate being slidable along the mast under the control of respective hydraulic actuators. The fork can be used to lift a load, for example for transporting ware in a store. The mast can be tilted with respect to the chassis to facilitate loading and unloading of the ware.

[0003] It is also known to mount a plurality of different types of material handling apparatuses on the fork-carrying plate of the industrial truck, such as translator, a rotator or a pincer, so as to perform a required material handling function. Hence, the material handling apparatus can be replaced, and the industrial truck can be operated with different material handling apparatus mounted on the fork-carrying plate slidably mounted on the mast.

[0004] When the material handling apparatus needs to be replaced, the controller of the industrial truck must be reconfigured in order to be capable to operate properly the currently mounted material handling apparatus. The operation of reconfiguring the controller might require some time and renders the operation of the industrial truck less efficient.

SUMMARY OF THE INVENTION

[0005] In view of the above, it is an object of the present invention to provide an industrial truck capable of achieving an improved efficiency in case the material handling apparatus mounted on the industrial truck is replaced. A further object of the invention is to shorten the time required to operate the industrial truck after the material handling apparatus mounted on the industrial truck is replaced. A further object of the invention is to achieve a safe and proper operation of the industrial truck in case of replacement of the material handling apparatus.

[0006] In view of the above objects, the present invention proposes an industrial truck including:

- a frame,
- a mast mounted on the frame in a rotatable manner around a substantially horizontal axis,
- a lifting element configured to slide along the mast, said lifting element being configured to support a material handling apparatus out of a plurality of material handling apparatuses of different types, wherein each material handling apparatus can be mounted on the lifting element;
- tilting means configured to tilt the mast;
- lifting means configured to lift the lifting element along the mast;
- a control unit configured to control the movement of the tilting means and of the lifting means under instructions inputted by an operator of the industrial truck;

characterized in that the industrial truck further includes means for acquiring information related to the material handling apparatus mounted or being currently mounted on the lifting element, e.g. including the type of the material handling apparatus;
wherein the control unit is configured to set one or more operational parameters of the industrial truck depending on the information related to the material handling apparatus acquired by the acquiring means, e.g. based on the type of the material handling apparatus,
the control unit being configured to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters.

[0007] Thanks to the present invention, the industrial truck can rapidly recognize the material handling apparatus which is mounted on the industrial truck and, based on this recognition, can properly reconfigure the operational parameters to be employed in the control of the industrial truck and of the material handling apparatus. Hence, the time required to operate the industrial truck after mounting a new material handling apparatus can be shortened and the replacement of the material handling apparatus is substantially eased.

[0008] According to a preferred embodiment, each of the above mentioned material handling apparatuses can be mounted on the lifting element in a releasable manner.

[0009] According to a preferred embodiment, the means for acquiring information related to the material handling apparatus are configured to acquire the information related to the material handling apparatus from the material handling apparatus mounted on the lifting element by establishing a communication with the material handling apparatus when the material handling apparatus is mounted on the lifting element. Accordingly, the acquisition of the information related to the material handling apparatus is performed by means of a direct communication between the material handling apparatus and the industrial truck, hence further facilitating the configuration of the control unit of the industrial truck when mounting a new material handling apparatus.

[0010] According to a preferred embodiment, the acquiring means includes a wireless receiver, preferably an NFC reader or an RFID reader, configured to receive the information related to the material handling apparatus from the material handling apparatus mounted on the lifting element. This arrangement permits to further improve the reconfiguration of the control unit upon mounting the new material handling apparatus on the lifting element of the industrial truck.

[0011] According to a preferred embodiment, the information related to the material handling apparatus includes an identification of the type of material handling apparatus, wherein the industrial truck includes a database storing a plurality of identifications of a type of material handling apparatus and a plurality of sets of operational parameters, each identification of a type of material handling apparatus being associated to a set of operational parameters; wherein the control unit is configured to control the industrial truck and/or the material handling apparatus mounted on the lifting element of the industrial truck according to the set of operational parameters stored in the database corresponding to the identification of a type of material handling apparatus acquired by the acquiring means. Thus, the control unit is capable to configure the operation parameters based on the content of a database of the industrial truck, whereas the amount of information to be acquired is confined to an identification of the type of material handling apparatus; accordingly, since the amount of information to be acquired is relatively small, transmission and/or inputting errors are reduced and reliable reconfiguration of the industrial truck can be achieved.

[0012] According to a preferred embodiment, the one or more operational parameters include one or more parameters for the control of the lifting means and/or of the tilting means and/or of a material handling function of the material handling apparatus mounted on the lifting element. Thus, the reconfiguration of the operational parameters can refer to any actuator involved in the operation of the material handling function performed by the system "industrial truck" + "material handling apparatus", specifically relating to both actuators on board of the industrial truck and actuators on board of the material handling apparatus. This enable proper configuration of the control unit for appropriately controlling the whole material handling function.

[0013] According to a preferred embodiment, the one or more operational parameters include any of a maximum load lifting height, a maximum truck speed, a maximum mast tilt angle, a maximum weight of the load that can be lifted by the material handling apparatus mounted on the lifting element or an indication of an inhibited combined maneuver. Hence, the industrial truck can be operated according to the correct operational ranges for the parameters involved in the material handling function, thereby ensuring a safe operation of the industrial truck upon replacement of the material handling apparatus.

[0014] According to a preferred embodiment, the industrial truck includes a pump for feeding oil to an hydraulic actuator of any of the lifting means, the tilting means and/or a material handling function of the material handling apparatuses mounted on the lifting element, wherein the operational parameters include a number of turns of a rotor of the pump. Hence, proper and safe operation of the hydraulic actuators can be achieved depending on the type of the material handling apparatus by controlling the operation of the pump of the industrial truck.

[0015] According to a preferred embodiment, the one or more operational parameters include parameters related to the currents to be fed to solenoids of valves for distributing oil to an hydraulic actuator of any of the lifting means, the tilting means or a material handling function of the material handling apparatus mounted on the lifting element. Hence, the pressure and flow rate in the hydraulic actuators of the system can be properly operated depending on the type of material handling apparatus mounted on the industrial truck, thus also achieving a desired level of safety.

[0016] According to the invention, it is further provided a system including an industrial truck as above defined and a plurality of material handling apparatuses configured to be mounted in a releasable manner on the lifting element of the industrial truck, wherein the plurality of material handling apparatuses includes one or more of the following:

- a translator configured to translate a load from a lateral side of the truck to the opposite lateral side thereof,
- a rotator configured to rotate a load around a horizontal axis,
- a pincer configured to pinch a load on opposite lateral sides thereof;
- one or more tines;
- a positioning apparatus configured to translate a load in a plurality of directions;
- one or more telescopic tines.

[0017] The invention further proposes a material handling apparatus configured to be mounted on a lifting element of an industrial truck,

characterized by comprising means for providing information related to the material handling apparatus to the industrial truck;
wherein the information related to the material handling apparatus enables a control unit of the industrial truck to set one or more operational parameters of the industrial truck and to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] The above and other advantages of the present invention will be illustrated with reference to example embodiments of the invention, described with reference to the appended drawings listed as follows.

Fig. 1 shows a schematic view of an industrial truck and of a material handling apparatus to be mounted on the industrial truck;
Figs. 2-4 show examples of material handling apparatuses that can be mounted on the industrial truck;
Fig. 5 shows a schematic view of components of the industrial truck and of the material handling apparatus according to a first embodiment of the invention;
Fig. 6-7 show flowcharts indicating the steps of configuring the operational parameters in some implementations of the first embodiment of the invention;
Fig. 8 shows a schematic view of components of the industrial truck and of the material handling apparatus according to a second embodiment of the invention;
Fig. 9-10 show flowcharts indicating the steps of configuring the operational parameters in some implementations of the second embodiment of the invention;
Fig. 11 shows a schematic view of a possible implementation of a control unit of the industrial truck and/or of the material handling apparatus.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0019] Figure 1 shows a schematic view of an industrial truck 10 according to an embodiment of the present invention, e.g. a forklift truck. The industrial truck 10 may be electrically driven or may include an endothermic motor. The industrial truck 10 includes a chassis 11 (or frame) forming an operator cabin 15, a mast 12 pivotally mounted on the chassis 11 and lifting element 13 (including e.g. a fork-carrying plate) for supporting a fork or another material handling apparatus 21 adapted to carry a load or, more generally, to handle material; the lifting element 13 is mounted on the mast 12 in a slidable manner along the mast 12. The mast 12 is pivotally mounted on the chassis 11 around the pivot which is preferably located close to the front axle of the truck 10. The mast 12 may be tilted around a horizontal axis over a range of directions encompassing a vertical direction. The industrial truck 10 includes tilting means configured to tilt the mast 12 and lifting means configured to lift the lifting element 13 along the mast 12; the tilting means and the lifting means can be implemented according to any known art using e.g. hydraulic actuators or equivalent means. Preferably, the industrial truck 10 includes one or more hydraulic actuators controlled by one or more solenoid valves. Also, the material handling apparatus 21 may include one or more hydraulic actuators controlled by one or more solenoid valves. The pump for feeding the hydraulic actuators of the industrial truck and/or of the material handling apparatus 21 is preferably mounted on board of the industrial truck 10.

[0020] The truck 10 further includes a control unit 40 (shown schematically in fig. 1) configured to control different functions of the industrial trucks, including the lifting operation of the lifting element 13, the tilting operation to tilt the mast 12 and possibly also the operation of one or more actuators of the material handling apparatus 21 mounted on the industrial truck 10. The control unit 40 is configured to control the movement of the tilting means and of the lifting means under instructions inputted by an operator of the industrial truck, e.g. by means of a user interface, UI, 70 (see fig. 5).

[0021] The lifting element 13 is configured to support a plurality of material handling apparatuses 21 of different types, wherein each material handling apparatuses can be mounted on the lifting element in a releasable manner; the lifting element 13 can support one material handling apparatus at a certain point in time; the material handling apparatus can be removed from the lifting element 13 and replaced by a material handling apparatus of a different type among the plurality of material handling apparatuses of different types. However, according to an alternative embodiment of the invention, a material handling apparatus 21 may be mounted on the lifting element 13 in a non-releasable manner, i.e. in a fixed manner. In figure 1, the material handling apparatus 21 is shown schematically in dashed lines; such material handling apparatus 21 may be of any known type to be used in conjunction with an industrial truck. For example, the material handling apparatus 21 may include one or more tines as shown in figure 2, a translator configured to translate a load from a lateral side of the truck to the opposite lateral side thereof as shown in figure 3, a pincer configured to pinch a load on opposite lateral sides thereof as shown in figure 4 or other types of material handling apparatuses, such as for example a rotator configured to rotate a load around a horizontal axis, a positioning apparatus configured to

translate a load in a plurality of directions, one or more telescopic tines. It is understood that also other type of material handling apparatuses 21 may be used in conjunction with the industrial truck 10 of the present invention. The material handling apparatus 21 includes attachment means 19 (see figure 2) and 20 (see figure 3) to be attached in a releasable manner to the industrial truck 10, specifically to the lifting element 13 of the industrial truck 10. The attachment means 19, 20 can be implemented according to any known art, e.g. including known releasable engagement elements to engage with the fork-carrying plate of the industrial truck.

[0022] According to the invention, the industrial truck 10 further includes means for acquiring information related to the material handling apparatus 21 mounted or being currently mounted on the lifting element 13.

[0023] The acquiring means of the industrial truck 10 can be implemented by means of a transceiver 50 adapted to communicate with the material handling apparatus 21 to collect the information related to the material handling apparatus 21 (see figure 5). The transceiver 50 is hereby understood as being any transmitting/receiving unit for communicating with the material handling apparatus, MHA, 21. The transceiver 50 may be configured to perform a bidirectional communication with the MHA 21, but it may also be configured only for receiving (or reading) the information from the MHA 21. The transceiver 50 may be a wireless receiver, for example an NFC reader or an RFID reader, configured to receive the information related to the material handling apparatus from the material handling apparatus mounted on the lifting element. Alternatively, the transceiver 50 may be connected via a cable to the MHA 21 when the MHA 21 is mounted on the industrial truck; for example, the transceiver 50 may be connected to the MHA 21 via a USB cable. The transceiver 50 may be configured to perform a communication with the MHA 21 according to a predefined communication protocol. Specifically, the transceiver 50 may be configured to be in communication with a transceiver 80 of the MHA 21. The transceiver 80 may be any suitable counterpart of the transceiver 50 of the industrial truck 10 as above described. E.g. the transceiver 80 may include a transponder, a transmitting/receiving unit, a transmitter connectable via a cable to the industrial truck 10 or the like.

[0024] Alternatively, the acquiring means of the industrial truck may also be implemented by the user interface, UI, 70 of the industrial truck (see figure 5), which is configured to receive as an input from the user the information related to the material handling apparatus (also referred to as MHA in the present disclosure). The user interface 70 can be implemented e.g. by means of a touchscreen, a keyboard or the like.

[0025] The control unit 40 is configured to set one or more operational parameters of the industrial truck 10 depending on the information related to the material handling apparatus 21 acquired by the acquiring means. Further, the control unit 40 is configured to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters.

[0026] The one or more operational parameters may include one or more parameters for the control of the lifting means and/or of the tilting means and/or of a material handling function of the material handling apparatus 21 mounted on the lifting element 13. For example, the one or more operational parameters may include any of a maximum load lifting height, a maximum truck speed, a maximum mast tilt angle or a maximum weight of the load that can be lifted by the material handling apparatus mounted on the lifting element. The one or more operational parameters may include also an indication of an inhibited combined maneuver; in this case, e.g., the indication may refer to a combination of inputted commands by the user (e.g. load translating command and load lifting command) that should be inhibited, i.e. that should not be carried out by the industrial truck even if the user inputs such a combined command; this might help increasing safety of the operation of the industrial truck. In other words, the one or more operational parameters may also relate to the inhibition of combined operations commanded by the user. Accordingly, the operational parameters may configure the reaction of the control unit 40 in case of unallowable combined maneuver inputted at the user interface 70 by the user.

[0027] The one or more operational parameters may be parameters for achieving a safe operation of the industrial truck on which the material handling apparatus is mounted.

[0028] The one or more operational parameters may be related to one or more of the following:

- the lifting function by the lifting element 13;
- the tilting function by the mast 12;
- auxiliary functions (such as the translation or the positioning of the forks, in case these functions are supported by the industrial truck).

[0029] In some preferred embodiments, the industrial truck 10 includes a pump for feeding oil to a hydraulic actuator of any of the lifting means, the tilting means and/or a material handling function of the material handling apparatuses 21 mounted on the lifting element 13. In this case, the operational parameters may advantageously include a number of turns of a rotor of the pump. The pump drive may be electric or endothermic. The regulation of the number of turns of the pump may advantageously guarantee the correct supply of the hydraulic actuator in terms of oil flow rate, thus achieving a desired level of safety depending on the type of MHA installed on the industrial truck 10 and also achieving an improved energetic efficiency.

[0030] In some preferred embodiments, the industrial truck 10 and/or the MHA 21 include valves for distributing oil to

a hydraulic actuator that are controlled by a solenoid. In these cases, the one or more operational parameters may preferably include parameters related to the currents to be fed to the solenoids of valves for distributing oil to an hydraulic actuator of any of the lifting means, the tilting means or a material handling function of the material handling apparatus mounted on the lifting element. In this case, the parameter may regulate the flow rate of the hydraulic actuators, e.g. for the management of the minimum speed, of the maximum speed or of the intermediate speed of the functions related to the mast 12 or of the functions related to the material handling apparatus 21.

[0031] The one or more operational parameters may also relate a variation of the residual load capacity of the industrial truck. In this case, the operational parameter may serve to output an alert to the user concerning the occurred variation of the residual load capacity or for providing to the user the updated load capacity.

[0032] The one or more operational parameters may also relate to the interdependence of the above-mentioned parameters, e.g. for advanced functionality or limitations.

[0033] The industrial truck 10 may be equipped, in an incremental and independent manner, with other sensor and/or electronic controls that may enable a further level of control of the functionality, as indicated in the following table:

Sensor/control	Parameter	Functionality
Solenoid valve proportional control of the hydraulic pressure	Currents to the solenoids of the hydraulic blocks (pressure)	Management of the feeding pressure of the various functionality
Fork height sensor	Lifting height	Maximum height, minimum height, intermediate or default height
Tilt angle sensor	Tilt inclination	Maximum inclination, minimum inclination, intermediate or default inclination
Truck speed control	Truck speed	Maximum speed, minimum speed, intermediate or default speed

[0034] Based on the sensors and the controls on the industrial truck, the interdependence of the above mentioned parameters may be extended to all relevant parameters.

[0035] In one embodiment, the means 50 for acquiring information related to the material handling apparatus are configured to acquire the information related to the material handling apparatus from the material handling apparatus 21 mounted on the lifting element 13 by establishing a communication with the material handling apparatus 21 when the material handling apparatus 21 is mounted on the lifting element 13. This allows for example to use a wireless transmission to convey the information relating to the MHA 21, such as RFID or NFC. These types of communication can ensure a reliable transfer of the required information when a mutual predetermined position of the industrial truck 10 and of the MHA 21 is achieved, such as in case the material handling apparatus 21 is mounted on the lifting element 13.

[0036] According to a first embodiment as described with reference to figures 5-7, the industrial truck 10 includes a database 60 storing a plurality of identifications of a type of material handling apparatus (such as an ID code of the MHA 21) and a plurality of sets of operational parameters, each identification of a type of material handling apparatus being associated to a set of operational parameters. In this case, the information related to the material handling apparatus that is acquired by the industrial truck 10 includes only an identification of the type of material handling apparatus 21. Accordingly, the control unit 40 is configured to control the industrial truck 10 and/or the material handling apparatus 21 mounted on the lifting element 13 according to the set of operational parameters stored in the database 60 corresponding to the identification of a type of material handling apparatus acquired by the acquiring means 50 or 70.

[0037] Figure 6 shows a first process for setting (or configuring) the operational parameters by means of the control unit 40 of the industrial truck in the first embodiment. In this case, the information relating to the MHA 21 is inputted by the user e.g. by means of the user interface, UI, 70 shown in figure 5.

[0038] Referring to figure 6, at step 31 the process is started; at step 32 it is determined whether a new MHA 21 has been mounted on the industrial truck 10. If the answer is "no", the industrial truck is ready for use (see step 33) and the process is terminated. If the answer is "yes" (i.e. a new MHA 21 has been installed on the industrial truck 10), the industrial truck is switched on at step 34. At step 35 the ID code of the MHA 21 is inputted. For example, the ID code can be inputted by means of a keyboard or a touchscreen of the UI 70 of the industrial truck; alternatively, the ID code could be inputted by means of a USB connection, NFC or RFID. At step 37 the control unit 40, based on the ID code previously inputted, retrieves (or load) the operational parameters associated to the ID code from the database 60 of the industrial truck. The operation parameters can include any of the above described parameters, such as the currents to the solenoids of the oleodynamic blocks, number of turns of the pump, tilt angle, lifting height, truck speed and so on. The loaded operational parameters are then stored in a memory of the control unit 40 and the industrial truck 10 is ready for use at step 38. The process of configuring the industrial truck is then terminated.

[0039] Figure 7 shows a second process for setting (or configuring) the operational parameters by means of the control unit 40 of the industrial truck in the first embodiment. In this case, the information relating to the MHA 21 is acquired at the industrial truck 10 by means of a communication with the MHA 21.

[0040] Referring to figure 7, at step 51 the process is started; at step 52 the industrial truck is switched on. At step 53, the industrial truck 10 automatically acquires the information related to the MHA 21, e.g. an ID code of the MHA 21. The acquisition of the ID code of the MHA occurs by means of a communication with the MHA 21, e.g. by means of RFID or NFC. However, also a cabled communication may be used to transfer the ID code, e.g. by means of a USB cable, following a predetermined communication protocol; the industrial truck 10 can acquire the ID code of the MHA (representing the information relating to the MHA) by means of the transceiver 50 and then transfer it to the control unit 40. At step 54, the control unit 40 determines whether a known MHA 21 has been newly installed on the industrial truck based on the acquired ID code. In this step, the control unit determines whether the MHA 21 mounted on the industrial truck is different from a previously mounted MHA 21, e.g. by comparing the ID code of the MHA currently mounted on the industrial truck with a previously stored ID code of a MHA 21 previously mounted on the industrial truck 10. If no new known MHA 21 is detected, the control unit 40 assumes that the MHA 21 has not been replaced and, hence, the process proceeds to step 55, i.e. the industrial truck is ready for use; the process is then terminated. If a new known MHA 21 is detected, at step 56 the control unit 40 retrieves the operational parameters associated to the ID code from the database 60 of the industrial truck. The operational parameters can include a set of any of the above discussed operational parameters. The new operational parameters are then loaded and stored in a memory of the control unit 40. At step 58 the industrial truck is then ready for use and the configuration process is terminated.

[0041] In this process of figure 7, the type of MHA (e.g. represented by the ID code of the MHA) is automatically detected each time the industrial truck 10 is switched on. When the industrial truck 10 detects a replacement of the MHA, the new corresponding operational parameters are updated automatically using the internal database 60 of the industrial truck 10. This allows to achieve a safe and fast reconfiguration of the industrial truck depending on the type of MHA.

[0042] According to a second embodiment as described with reference to figures 8-10, the industrial truck 10 does not include a database 60 similar to figure 5. To the contrary, in this embodiment, the operational parameters associated to a MHA are stored in the MHA 21a itself, preferably in the non-volatile memory 81 of the MHA 21a as shown in figure 8. In figure 8, the MHA 21a includes a transceiver 80 for the communication with the transceiver 50 of the industrial truck 10a, the memory 81 for storing the operational parameter related to the MHA 21a and a control unit 82. It is noted that also in the other embodiments the MHA 21 might include advantageously a control unit 82 to control either the transmission of the information related to the MHA or for controlling any auxiliary function of the MHA 21a. In the second embodiment, the information related to the material handling apparatus 21a acquired by the acquiring means of the industrial truck 10a includes the operational parameters to be set by the control unit 40. In other words, instead of acquiring an ID code of the MHA as in the previous embodiments, in the second embodiment the industrial truck 10a acquires the operational parameters related to the newly installed MHA 21a. In this embodiment, the operational parameters are transmitted from the MHA 21a to the industrial truck according to a predetermined communication protocol, either wirelessly or via a cabled communication channel. The communication protocol might be e.g. SAE J1939 for vehicles.

[0043] Figure 9 shows a first process for setting (or configuring) the operational parameters by means of the control unit 40 of the industrial truck 10a in the second embodiment.

[0044] Referring to figure 9, at step 61 the process is started; at step 62 it is determined whether a new MHA has been mounted on the industrial truck. If no new MHA has been mounted, the process proceeds to step 63 and the industrial truck is ready for use; then the procedure is terminated. If a new MHA has been mounted on the industrial truck, the industrial truck 10a is switched on at step 64. Then, at step 65 the MHA 21a transmits to the industrial truck 10 the operational parameters for the operation of the system including the industrial truck 10a and the MHA 21a. The transfer of the operational parameters can occur wirelessly or via a cable by means of the transceivers 80 and 50 of the MHA 21a and of the industrial truck 10a, respectively. The communication occurs according to a predefined communication protocol. The set of operational parameters transmitted from the MHA 21a to the industrial truck 10a includes any of the above disclosed operational parameters (see reference 66 in figure 9). At step 67 the industrial truck 10a receives the operational parameters and interprets the received information based on the predefined communication protocol. Subsequently, at step 68 the industrial truck 10a stores the operational parameters of the MHA 21a in a memory of the control unit 40 and the industrial truck 10 is then ready for use at step 69. The configuration process is then terminated.

[0045] Figure 10 shows a second process for setting (or configuring) the operational parameters by means of the control unit 40 of the industrial truck 10a in the second embodiment.

[0046] Referring to figure 10, at step 71 the process is started; at step 72 the industrial truck 10a is switched on. At step 73 the industrial truck 10a automatically acquires the ID code of the MHA 21a mounted on the industrial truck. Based on the acquired ID code, at step 74 the industrial truck 10a determines whether a new MHA 21a has been mounted on the industrial truck compared to a MHA previously mounted on the industrial truck. If no new MHA is detected, the industrial truck is considered ready for use at step 75 and the procedure is terminated. If a new MHA is detected, the MHA 21a transfers the operational parameters to the industrial truck 10a by means of the transceivers 80 and 50 (see

step 76); the transfer of the operational parameters may be triggered by a request transmitted by the industrial truck 10a upon detecting the new MHA 21a. The operational parameters transmitted from the MHA 21a to the industrial truck 10a can be any set of operational parameters described in the present disclosure (see step 77). At step 78 the industrial truck 10a receives and interprets the operational parameters based on the predefined communication protocol. At step 79 the operational parameters are then stored in the control unit 40 and the industrial truck 10a is then considered ready for use. The process is then terminated.

[0047] In this embodiment, the MHA 21a stores the operational parameters and is configured to provide the operational parameters to the industrial truck 10a as the information related to the MHA. The transmission of the operational parameters from the MHA to the industrial truck may be triggered by a request transmitted from the industrial truck 10a to the MHA 21a. The request for the operational parameters may be triggered by a detection of a replaced MHA mounted on the lifting element 13 by the industrial truck 10a. The detection of the MHA is performed each time when switching on the industrial truck by acquiring an ID code of the MHA mounted on the lifting element.

[0048] According to an aspect of the invention, a system is provided including an industrial truck as above described and a plurality of material handling apparatuses configured to be mounted in a releasable manner on the lifting element 13 of the industrial truck. The plurality of material handling apparatuses includes one or more of the following:

- a translator configured to translate a load from a lateral side of the truck to the opposite lateral side thereof,
- a rotator configured to rotate a load around a horizontal axis,
- a pincer configured to pinch a load on opposite lateral sides thereof;
- one or more tines;
- a positioning apparatus configured to translate a load in a plurality of directions;
- one or more telescopic tines.

[0049] According to an aspect of the invention, a material handling apparatus configured to be mounted on a lifting element 13 of an industrial truck is provided. The material handling apparatus 21 comprises means for providing information related to the material handling apparatus to the industrial truck, such as e.g. the transceiver 80 shown in figure 5; the information related to the material handling apparatus enables a control unit of the industrial truck to set one or more operational parameters of the industrial truck and to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters. Preferably, the material handling apparatus may be configured to be mounted on a lifting element 13 of an industrial truck in a releasable manner, i.e. such that the material handling apparatus may be removed from the lifting element and replaced by another material handling apparatus, for example of a different type. However, the material handling apparatus may be also mounted on the lifting element of the industrial truck in a fixed manner, i.e. such that it cannot be released. In this latter case, the present invention achieves the advantage that the system including the industrial truck and the material handling apparatus can be manufactured and configured in an efficient and timely manner, by additionally reducing the possibility of errors in the configuration of the operational parameters.

[0050] According to a further aspect of the invention, in any of the above described embodiments, the control unit 40 is configured to control a material handling function performed by the material handling apparatus 21 mounted on the lifting element 13, wherein the one or more operational parameters include parameters for the control of a material handling function of the material handling apparatus 21.

[0051] In a preferred embodiment, upon switching on of the industrial truck, the industrial truck is configured to acquire an identification of the material handling apparatus from the material handling apparatus and is configured to determine, based on the acquired identification, whether a new material handling apparatus has been mounted on the industrial truck. If it is determined that a new material handling apparatus has been mounted on the industrial truck, the industrial truck initiates a reconfiguration of operational parameters.

[0052] Fig. 11 shows a possible implementation of the control unit 40 of the industrial truck. In an embodiment, the control 40 includes a processor 42, a memory 43 and a I/O interface 41. The processor is configured to execute a control software stored on the memory 43 to execute any of the functions of the control unit 40 as above described. When executing the control software, the processor 42 receives as input the information from the sensors of the industrial truck and/or of the material handling apparatus by means of the I/O interface 41 and output control signals to the actuators of the industrial truck and/or of the material handling apparatus using the I/O interface 41 as well. The I/O interface 41 is also communicably connected to the transceiver 50 of the industrial truck to exchange information with the material handling apparatus 21, 21a. The I/O interface 41 is also communicably connected to user interface, UI, 70 of the industrial truck 10 to receive inputs from the user and to output alerts or other information relating to the industrial truck. Also other possible implementations of the control unit can be conceived, e.g. including a plurality of distributed processors or the like. The control unit of the material handling apparatus may have a similar hardware configuration as the control unit 40 above described.

[0053] The above description of embodiments applying the innovative principles of the invention is provided solely for

the purpose of illustrating said principles and must thus not be considered as limiting the scope of the invention claimed herein.

Claims

1. An industrial truck including:

   - a frame (11),
   - a mast (12) mounted on the frame in a rotatable manner around a substantially horizontal axis,
   - a lifting element (13) configured to slide along the mast (12), said lifting element (13) being configured to support a material handling apparatus out of a plurality of material handling apparatuses (21, 21a) of different types, wherein each material handling apparatus can be mounted on the lifting element;
   - tilting means configured to tilt the mast (12);
   - lifting means configured to lift the lifting element (13) along the mast (12);
   - a control unit (40) configured to control the movement of the tilting means and of the lifting means under instructions inputted by an operator of the industrial truck;

   characterized in that the industrial truck (10) further includes means for acquiring information related to the material handling apparatus mounted or being currently mounted on the lifting element including an identification of the type of material handling apparatus;
   wherein the control unit is configured to set one or more operational parameters of the industrial truck including any of a maximum load lifting height, a maximum truck speed, a maximum mast tilt angle, a maximum weight of the load that can be lifted by the material handling apparatus mounted on the lifting element or an indication of an inhibited combination of maneuvers, depending on the identification of the type of material handling apparatus,
   the control unit (40) being configured to operate the industrial truck and/or the material handling apparatus mounted on the lifting element based on the set one or more operational parameters.

2. An industrial truck according to claim 1, wherein the means for acquiring information related to the material handling apparatus are configured to acquire the information related to the material handling apparatus from the material handling apparatus mounted on the lifting element (13) by establishing a communication with the material handling apparatus when the material handling apparatus is mounted on the lifting element (13).

3. An industrial truck according to claim 2, wherein the acquiring means (50) includes a wireless receiver, preferably an NFC reader or an RFID reader, configured to receive the information related to the material handling apparatus from the material handling apparatus mounted on the lifting element (13).

4. An industrial truck according any of the preceding claims,

   wherein the industrial truck (10) includes a database (60) storing a plurality of identifications of a type of material handling apparatus and a plurality of sets of operational parameters, each identification of a type of material handling apparatus being associated to a set of operational parameters;
   wherein the control unit (40) is configured to control the industrial truck (10) and/or the material handling apparatus (21) mounted on the lifting element of the industrial truck according to the set of operational parameters stored in the database (60) corresponding to the identification of a type of material handling apparatus acquired by the acquiring means.

5. An industrial truck according any of the preceding claims, wherein the one or more operational parameters include one or more parameters for the control of the lifting means and/or of the tilting means and/or of a material handling function of the material handling apparatus (21, 21a) mounted on the lifting element (13).

6. An industrial truck according any of the preceding claims, wherein the industrial truck includes a pump for feeding oil to an hydraulic actuator of any of the lifting means, the tilting means and/or a material handling function of the material handling apparatuses (21, 21a) mounted on the lifting element (13), wherein the operational parameters include a number of turns of a rotor of the pump.

7. An industrial truck according any of the preceding claims, wherein the one or more operational parameters include parameters related to the currents to be fed to solenoids of valves for distributing oil to an hydraulic actuator of any

of the lifting means, the tilting means or a material handling function of the material handling apparatus (21, 21a) mounted on the lifting element (13).

8. A system including an industrial truck (10) according to any of claims 1-7 and a plurality of material handling apparatuses (21, 21a) configured to be mounted in a releasable manner on the lifting element (13) of the industrial truck, wherein the plurality of material handling apparatuses includes one or more of the following:

- a translator configured to translate a load from a lateral side of the truck to the opposite lateral side thereof,
- a rotator configured to rotate a load around a horizontal axis,
- a pincer configured to pinch a load on opposite lateral sides thereof;
- one or more tines;
- a positioning apparatus configured to translate a load in a plurality of directions;
- one or more telescopic tines.

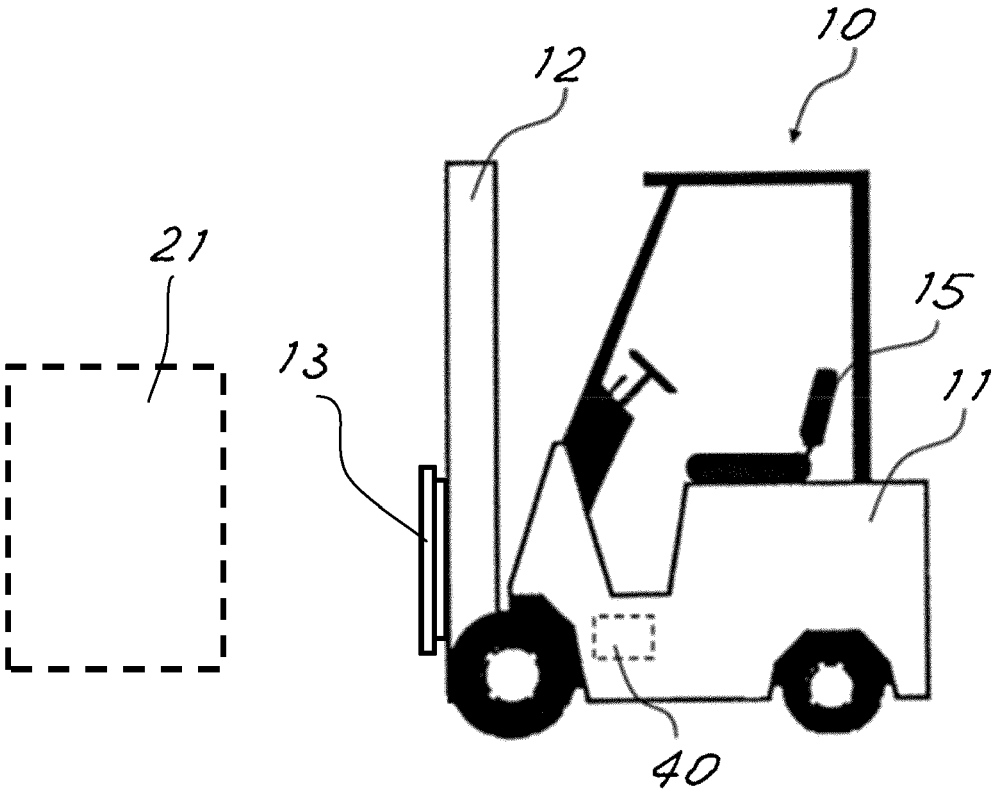

Fig. 1

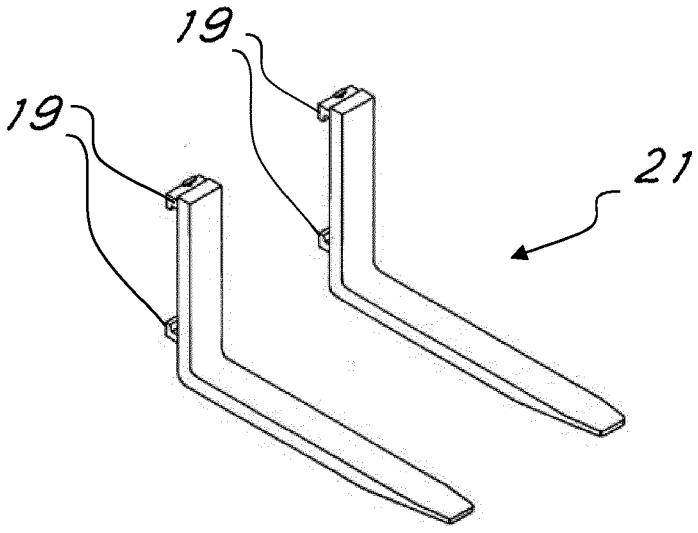

Fig. 2

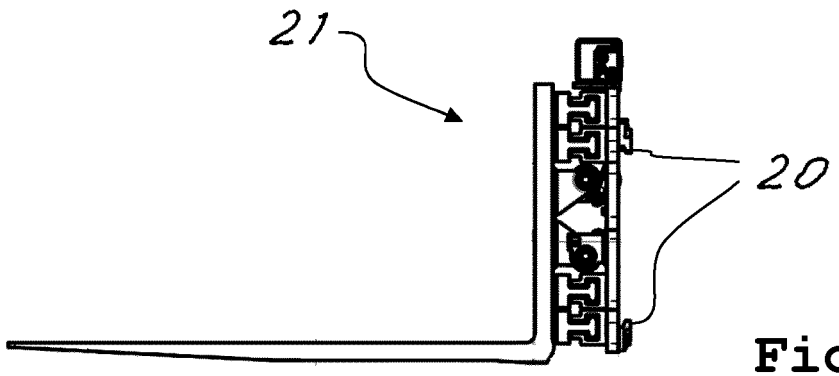

Fig. 3

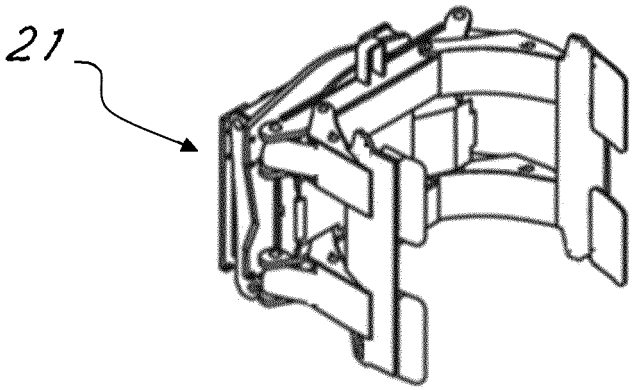

Fig. 4

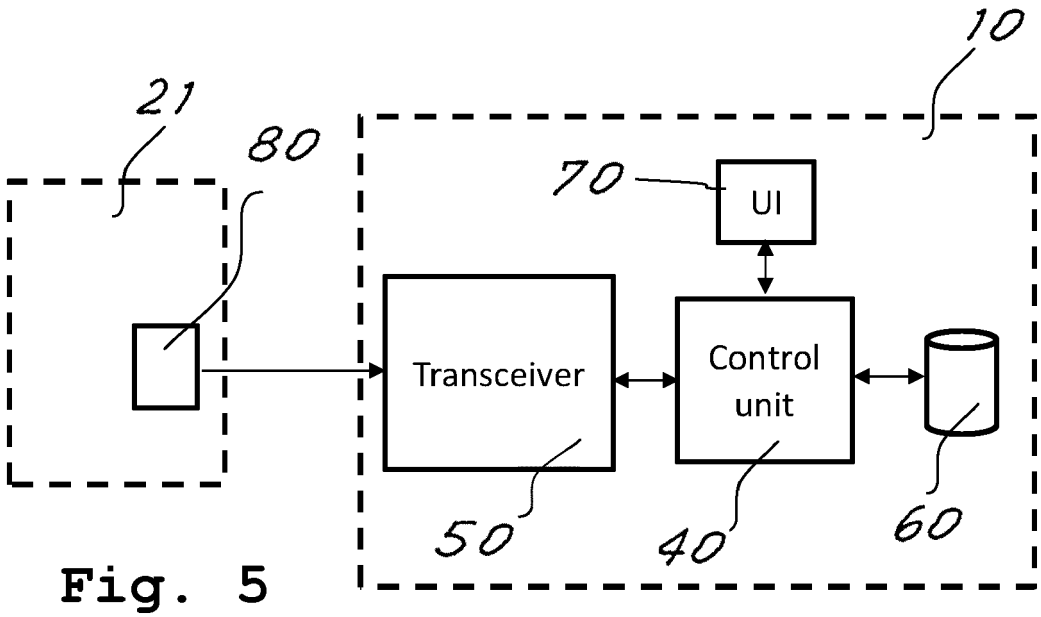

Fig. 5

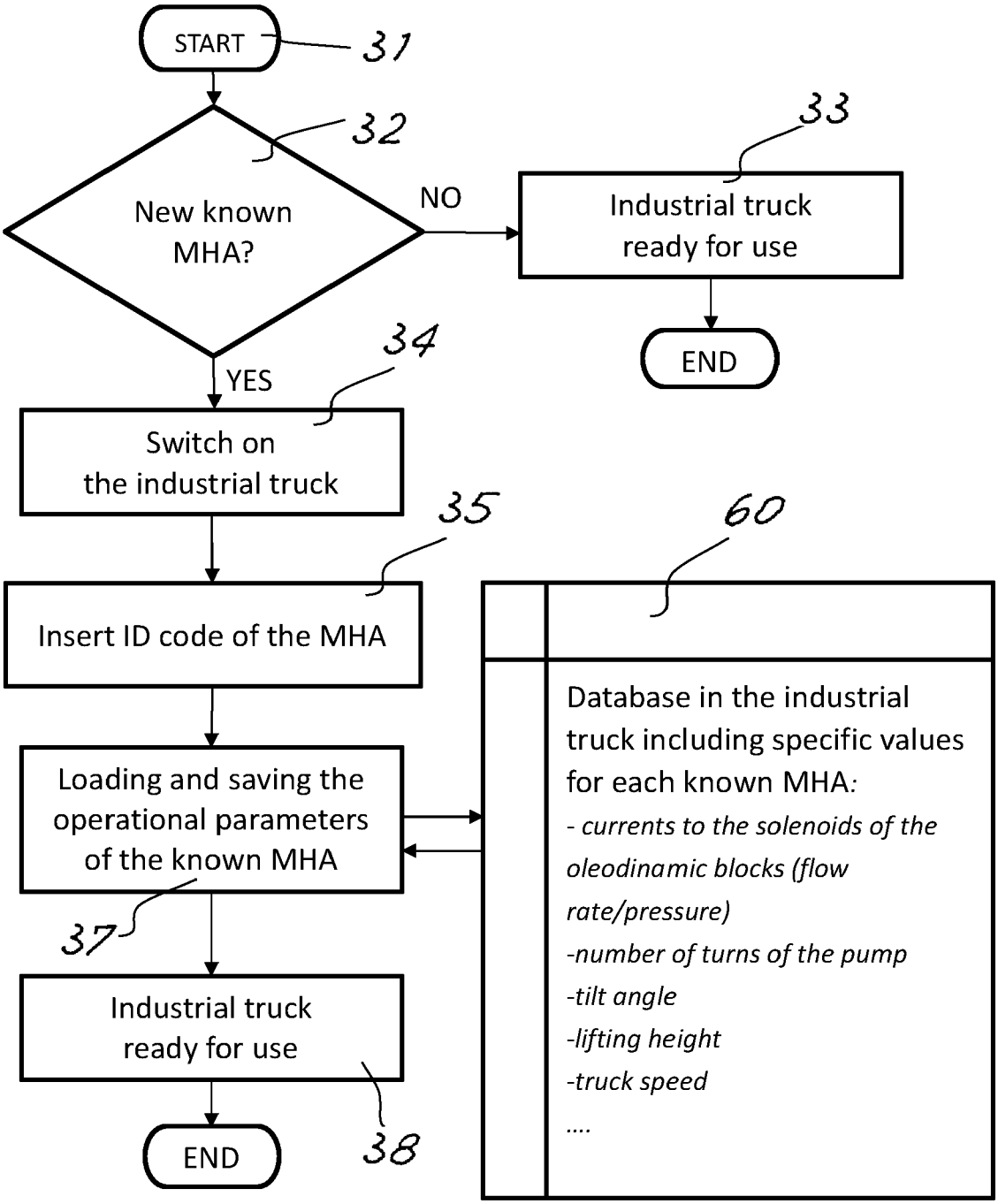
START
31
32
New known MHA?
NO
33
Industrial truck ready for use
END
YES
34
Switch on the industrial truck
35
Insert ID code of the MHA
Loading and saving the operational parameters of the known MHA
37
Industrial truck ready for use
END
38
60
Database in the industrial truck including specific values for each known MHA:
- currents to the solenoids of the oleodinamic blocks (flow rate/pressure)
-number of turns of the pump
-tilt angle
-lifting height
-truck speed
....

Fig. 6

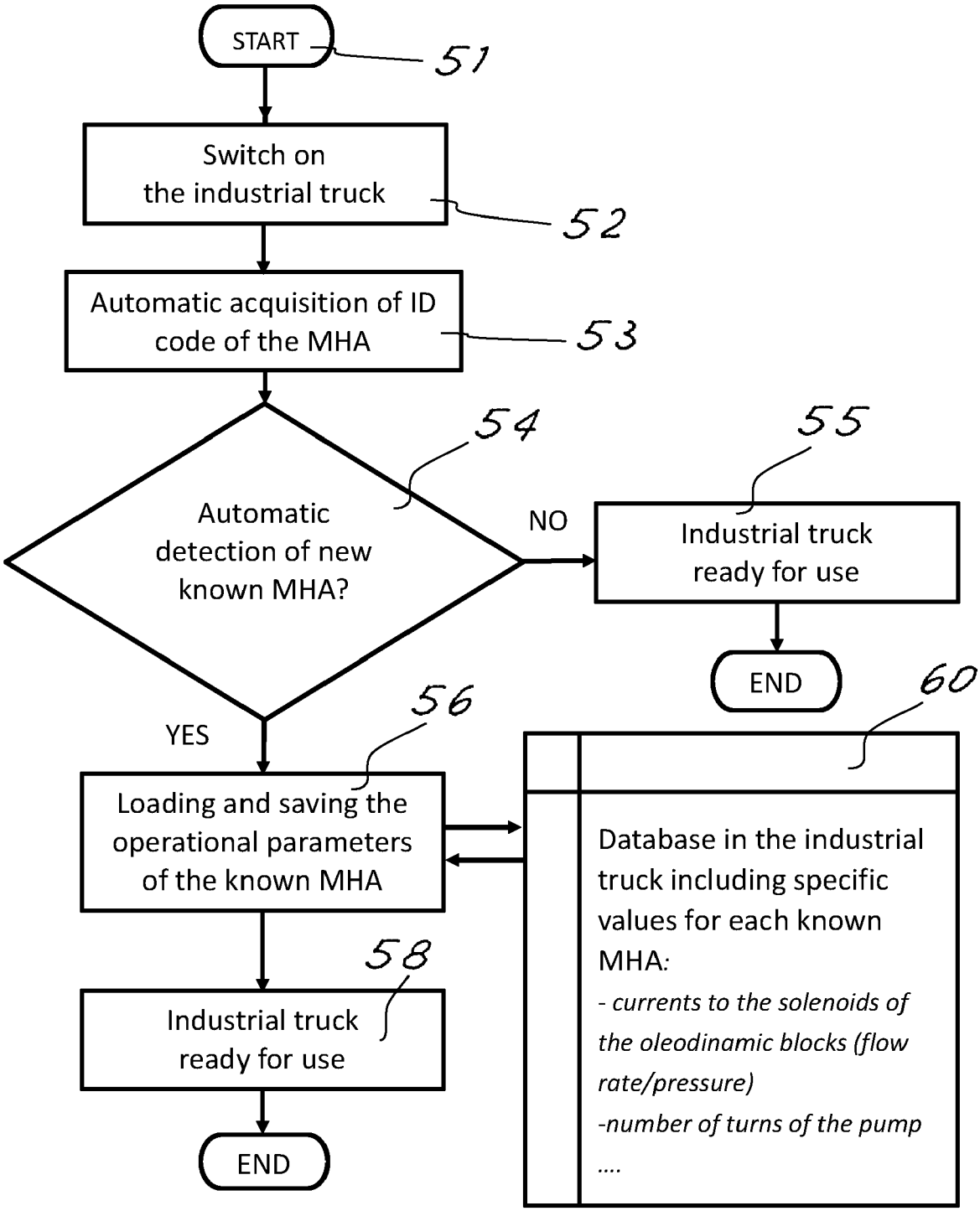
START
51
Switch on the industrial truck
52
Automatic acquisition of ID code of the MHA
53
Automatic detection of new known MHA?
54
NO
55
Industrial truck ready for use
END
YES
56
Loading and saving the operational parameters of the known MHA
58
Industrial truck ready for use
END
60
Database in the industrial truck including specific values for each known MHA:
- currents to the solenoids of the oleodinamic blocks (flow rate/pressure)
-number of turns of the pump
....

Fig. 7

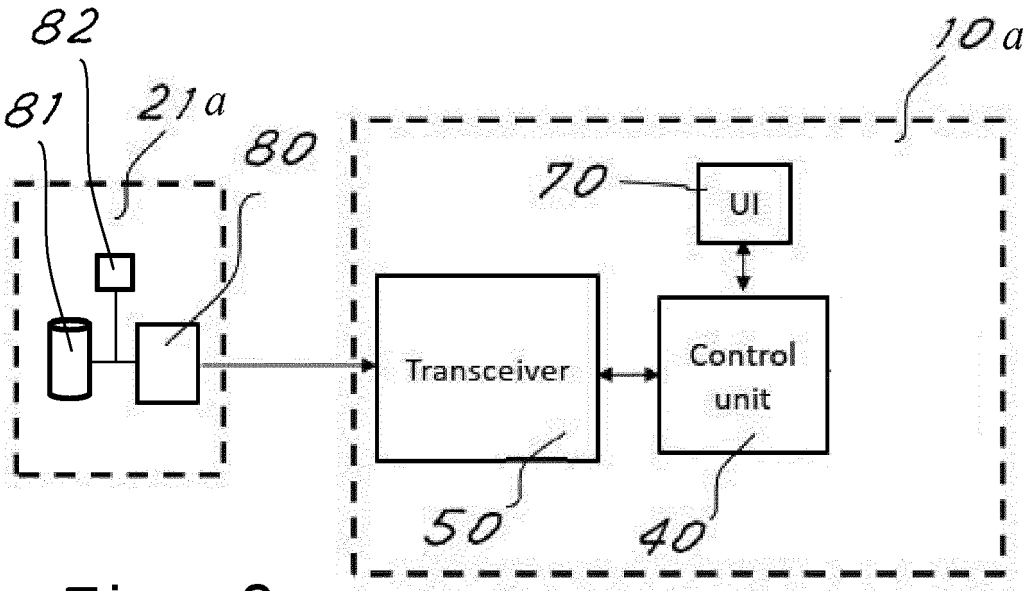

Fig. 8

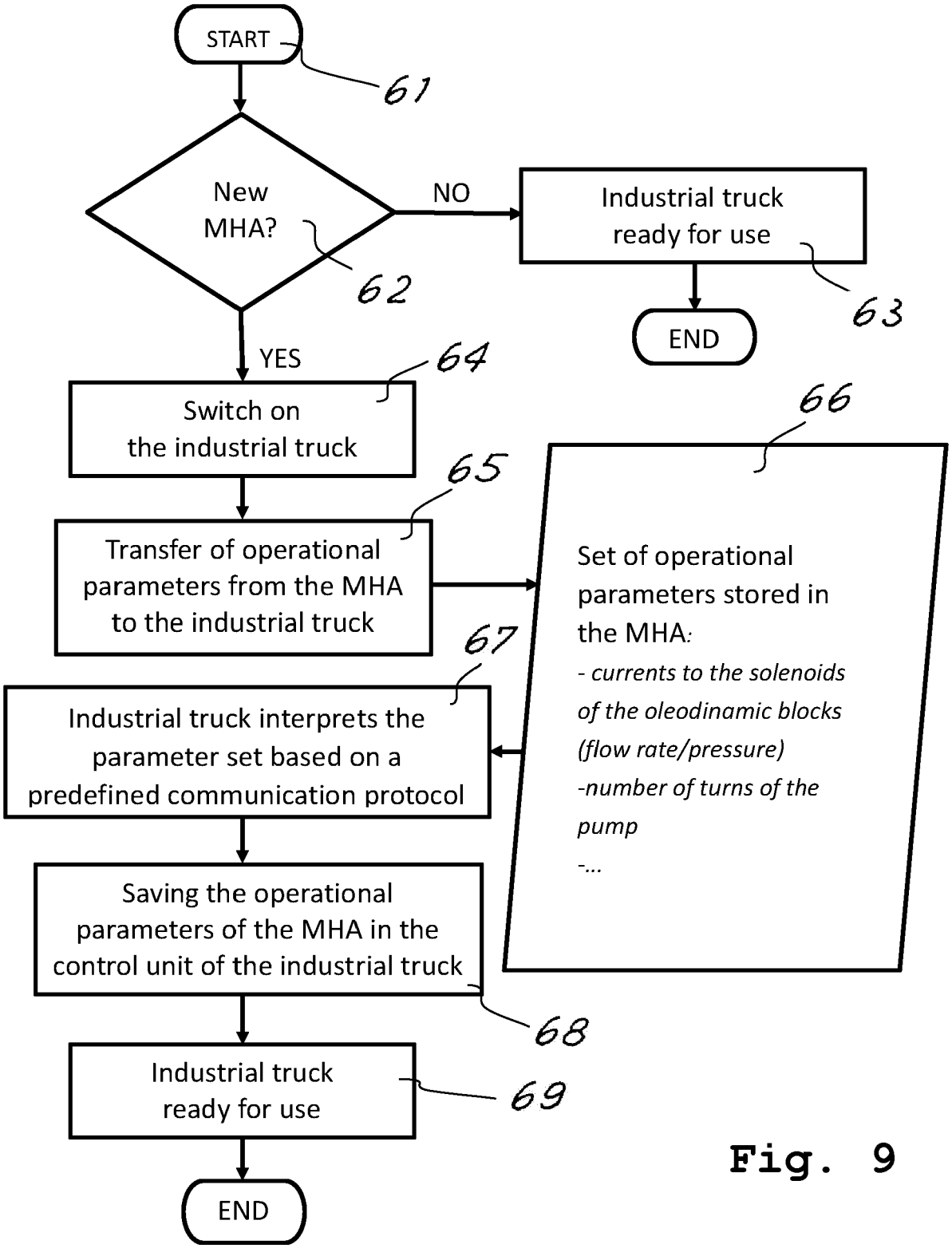
START
61
New MHA?
62
NO
Industrial truck ready for use
63
END
YES
64
Switch on the industrial truck
65
Transfer of operational parameters from the MHA to the industrial truck
66
Set of operational parameters stored in the MHA:
- currents to the solenoids of the oleodinamic blocks (flow rate/pressure)
-number of turns of the pump
-...
67
Industrial truck interprets the parameter set based on a predefined communication protocol
Saving the operational parameters of the MHA in the control unit of the industrial truck
68
Industrial truck ready for use
69
END

Fig. 9

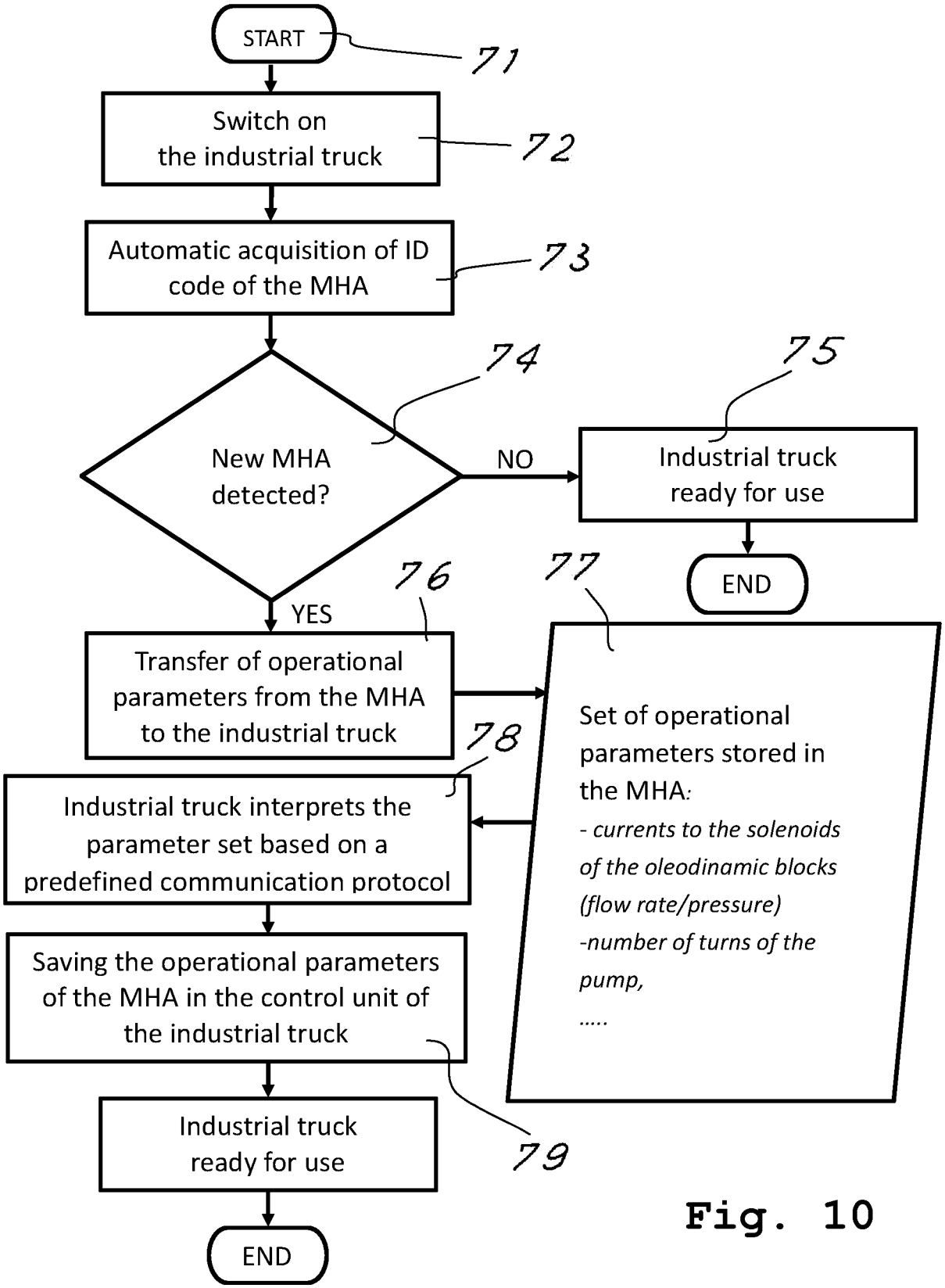
START
71
Switch on the industrial truck
72
Automatic acquisition of ID code of the MHA
73
New MHA detected?
74
NO
75
Industrial truck ready for use
END
YES
76
Transfer of operational parameters from the MHA to the industrial truck
77
Set of operational parameters stored in the MHA:
- currents to the solenoids of the oleodinamic blocks (flow rate/pressure)
-number of turns of the pump,
.....
78
Industrial truck interprets the parameter set based on a predefined communication protocol
Saving the operational parameters of the MHA in the control unit of the industrial truck
79
Industrial truck ready for use
END

Fig. 10

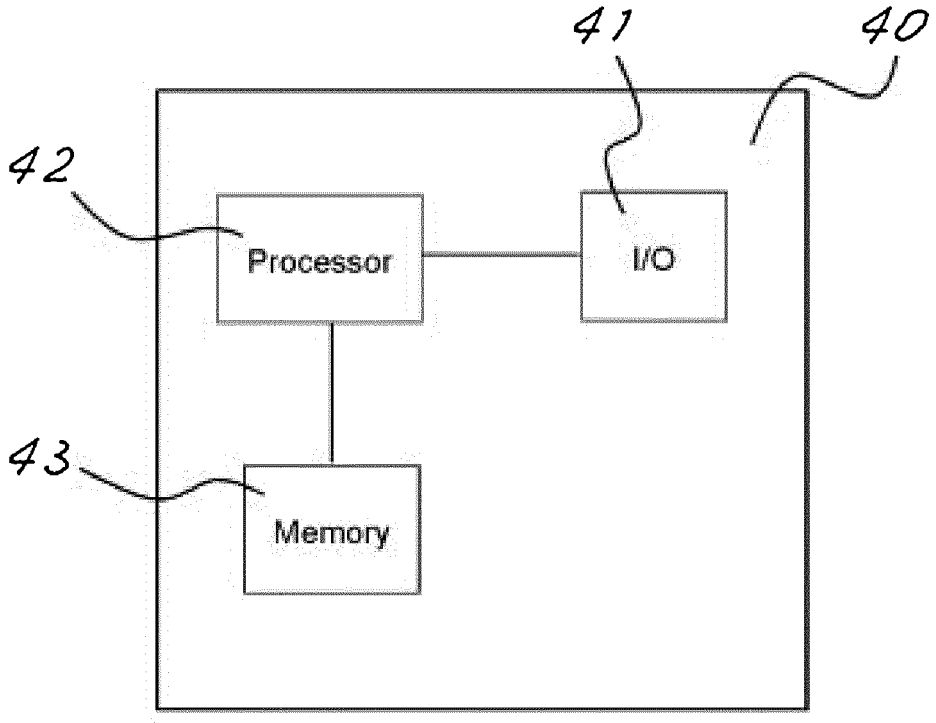

Fig. 11

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 4668

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Y	WO 2014/106700 A1 (MANITOU BF [FR]) 10 July 2014 (2014-07-10) * abstract * * page 2, line 1 - line 6 * * page 2, line 20 - line 21 * * page 3, line 6 - line 13 * * page 5, line 5 - line 15 * * page 5, line 21 - line 23 * * page 7, line 6 - line 16 * * page 9, line 15 - page 10, line 14 * * figures *	1-8	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	28 November 2022	Cabral Matos, A

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EUROPEAN SEARCH REPORT

Application Number
EP 22 18 4668

DOCUMENTS CONSIDERED TO BE RELEVANT

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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
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