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(54) **CRANE AND METHOD FOR OPERATING A CRANE**

KRAN UND VERFAHREN ZUM BETREIBEN EINES KRANS

GRUE ET PROCÉDÉ DE FONCTIONNEMENT D'UNE GRUE

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## Description

### Field of invention

**[0001]** The present invention relates to a crane and a method for operating a crane. More particularly, the invention relates to a method for operating a crane to perform a task automatically without manual assistance.

### Prior art

**[0002]** The operation of cranes can be a complex and challenging task. Especially, when the operator has to avoid collision with objects that are difficult to strike during movement of the lifting system of the crane. Nowadays, manual control of the lifting structures is applied per default. Accordingly, control of a crane requires full attention of the operator throughout all steps of the lifting tasks.

**[0003]** WO2015001401A1 discloses a crane and a method of controlling a crane that comprises a lift system configured to be arranged in a plurality of configurations. The lifting system comprises a plurality of structures that are movably arranged relative to each other and actuator adapted to move the structures relative to each other.

**[0004]** In order to assist the operator and ease the operation of the crane, it would be desirable to provide a method and a crane that allows certain crane tasks to be carried out automatically by the crane.

**[0005]** WO2015113084A1 discloses a method for controlling a lorry crane according to the preamble of claim 1. The crane controller is configured to be operated in a first operating mode in which the crane can be freely operated by a user using control commands and in a second operating mode that can be activated by the user, in which the crane geometry is performed in a predetermined sequence of movements by the crane control is changeable. This solution, however, only provides a single fixed path determined at a single fixed initial position.

**[0006]** CN201358142Y discloses an automatic control system for a telescopic boom. This solution, however, only provides a fixed path determined on the basis of manually selected starting position and a manually selected ending position.

**[0007]** Accordingly, it is desirable to be able to provide an improved controller and a method for controlling a crane in a more sophisticated manner.

**[0008]** Thus, it is an object of the present invention to provide a method and a crane that allows certain crane tasks to be carried out by the crane automatically in a more sophisticated manner.

### Summary of the invention

**[0009]** The object of the present invention can be achieved by a method as defined in claim 1 and by a crane having the features as defined in claim 9.

**[0010]** Preferred embodiments are defined in the de-

pendent subclaims, explained in the following description and illustrated in the accompanying drawings.

**[0011]** The method according to the invention is a method for controlling a lorry crane, having a lifting system configured to be arranged in a plurality of configurations, wherein the lifting system comprises a plurality of structures moveably arranged relative to each other and one or more actuators arranged to move the structures relative to each other, wherein the method comprises the following steps:

- selecting a first configuration among a plurality of configurations by means of a control system comprising an operable control unit;
- selecting a second configuration among a plurality of configurations by means of the control unit;
- activating the control unit to automatically bringing the lifting system from the first configuration into the second configuration by using one or more actuators,

wherein the method comprises the step of detecting the length of a structure of the lifting system and/or an angular position of a structure of the lifting system, wherein the control unit applies the length of a structure and/or the angular position a structure to calculate a path, through which path the control unit brings the lifting system from the first configuration into the second configuration by using one or more actuators, wherein the path is determined continuously during the operation of the lifting system, wherein the method comprises the step of keeping the structures in positions, in which the distance between the structures and one or more zones and/or positions is larger than a predefined length.

**[0012]** Hereby, it is possible to bring the lifting system of the crane automatically from the first configuration to the second configuration without any action required from the operator in a more sophisticated manner. The method is capable of continuously determining the most optimum path and automatically operate the crane accordingly. Moreover, the method makes it possible to operate a crane in a safer manner.

**[0013]** The lifting system comprises a plurality of structures moveably arranged relative to each other. These structures may be a crane base, a column being rotatably attached to the crane base, a jib comprising a number of booms. In a preferred embodiment, the structures may comprise a plurality of booms displaceable arranged with respect to each other. The plurality of booms may preferably be arranged in a telescopic manner with respect to each other.

**[0014]** The lifting system comprises one or more actuators arranged to move the structures relative to each other. The actuators may be of any suitable size and type. In a preferred embodiment, the actuators are formed as hydraulic cylinders.

**[0015]** The method comprises the step of selecting a first configuration by means of a control system compris-

ing an operable control unit.

**[0016]** The method comprises the step of selecting a second configuration by means of the control unit.

**[0017]** The first configuration and/or the second configuration may e.g. be selected from a predefined list or may be selected by any indication means e.g. by pointing out a position on a map on a user interface (e.g. a display). The first and/or second configurations may be positions (e.g. lifting positions of a load), it may alternatively be a configuration of a boom/crane arm such as an un-folded configuration of the boom/crane arm or a folded configuration of the boom/crane arm.

**[0018]** The method comprises the step of activating the control unit to automatically bringing the lifting system from the first configuration into the second configuration by using one or more actuators.

**[0019]** It may be an advantage that the first configuration and/or the second configuration is a position of a load being carried by the crane or a position of a structure of the lifting system. This means that the first configuration and/or the second configuration can be defined by the position, at which a load carried by the crane or to be carried by the crane is located.

**[0020]** It may be beneficial that the first configuration and/or the second configuration are selected from a list being visibly available on a user interface. Hereby, the operator can easily select among predefined configurations. The list may include numbers and/or other text or symbols.

**[0021]** In one embodiment, one configuration may be the lifting system in a folded configuration, in which the lifting system takes up less space than during lifting tasks.

**[0022]** In another embodiment, one configuration may be the lifting system in an un-folded configuration, in which the lifting system is ready to lift a load (e.g. from a first position to another position).

**[0023]** It may be advantageous that the method comprises the step of selecting the first configuration and/or the second configuration by indicating a position in a map displayed on a user interface or by using an external transmitter unit. Hereby, the selecting process is eased in a user-friendly manner. Furthermore, in some applications it allows the operator to get an overview over the surrounding.

**[0024]** The method comprises the step of keeping the structures in positions, in which the distance between the structures and one or more zones and/or positions is larger than a predefined length. Hereby, it is possible to avoid collision between the lifting system and objects positioned in said zones or positions. Accordingly, the invention ensures that fragile objects are protected from impacts and contact with the lifting system. This is of major importance if a lorry crane carries fragile cargo that is not resistant to collision with the lifting system of the crane.

**[0025]** The method is furthermore capable of protecting moving objects. The position of moving objects (e.g. a human, an animal or a vehicle) may be detected by any

suitable detection units, e.g. visual sensors (e.g. cameras).

**[0026]** It may be an advantage that the method comprises the step of automatically stopping the actuators when the distance between the structures and the one or more zones and/or positions is equal to or smaller than the predefined length. Hereby, it is possible to control the crane in a safe manner, in which collision with objects can be prevented. It is by way of example possible to predefine the cab of a lorry to be a "safe zone", wherein the lifting system is required to be provided within a predefined minimum distance to the safe zone.

**[0027]** It may be beneficial that the method comprises the step of automatically reducing the rotational and/or linear speed of one or more of the structures of the lifting system when the distance between the structures and the one or more zones and/or positions is equal to or smaller than the predefined length. Reducing the speed may be accomplished by controlling one or more of the actuators. Hereby, it is possible to control the crane in an even more safe manner, because the speed of structures of the lifting system can be reduced when the structures approach predefined positions or zones.

**[0028]** It may be advantageous that the method comprises the step of detecting one or more zones and/or positions by using one or more sensors.

**[0029]** It may be beneficial that the zones and/or positions are predefined or are set by default or set by the user/operator of the crane.

**[0030]** It may be advantageous that the one or the one or more sensors is a camera, an ultrasonic sensor, a proximity sensor or an optic distance sensor.

**[0031]** By using one or more cameras, it is possible to visually detect e.g. moving objects and optionally carry out processing in order to determine if the object is a critical object so that the lifting system should be stopped or if the moving object is out of the critical range of the lifting system (e.g. a dog running away from the crane). It may be an advantage that the method comprises the step of carrying out calculations in order to recognise one or more detected objects in order to make decisions according to a predefined scheme.

**[0032]** By using an ultrasonic sensor, it is possible to detect the distance to one or more objects.

**[0033]** By using a proximity sensor, it is possible to detect if an object is within a predefined range from a predefined area (e.g. a structure of the lifting system).

**[0034]** By using an optic distance sensor, it is possible to detect one or more distances optically.

**[0035]** It may be an advantage that the control unit comprises an object recognition unit configured to recognise one or more objects of predefined size and/or geometry and/or speed based on data provided by means of a camera. Hereby, it is possible to recognise one or more objects and take this into account e.g. in order to stop the movement of the lifting system or to move the lifting system away from the object in order to avoid collision. The objects may be moving objects such as a human or

an animal. The objects may also be a vehicle such as a car, a bicycle or a motorcycle.

**[0036]** The method comprises the step of detecting the length of a structure of the lifting system and/or an angular position of a structure of the lifting system, wherein the control unit applies the length of a structure and/or the angular position of a structure to calculate a path, through which path the control unit brings the lifting system from the first configuration into the second configuration by using one or more actuators. Due to the constraints in the lifting system, detection of the length and angles of the structures of the lifting system will provide information sufficient to calculate one or more possible paths through which the lifting system can be brought from the first configuration into the second configuration by using one or more actuators.

**[0037]** The term "angular position" may include an angle between adjacent structures or an angle of a structure relative to a predefined orientation (e.g. vertical or horizontal).

**[0038]** It may be an advantage that the method comprises the step of regulating the speed (translation and rotation) of the structures in dependency of the distance between the structures and the one or more zones and/or positions.

**[0039]** The crane according to the invention is a lorry crane that comprises a lifting system configured to be arranged in a plurality of configurations, wherein the lifting system comprises:

- a plurality of structures moveably arranged relative to each other;
- one or more actuators arranged to move the structures relative to each other,

wherein the crane comprises a control system comprising an operable control unit configured to:

- select a first configuration among a plurality of configurations;
- select a second configuration among a plurality of configurations and
- activate the control unit to automatically bringing the lifting system from the first configuration into the second configuration by using one or more actuators, wherein the control unit is configured to detect the length of a structure of the lifting system and/or an angular position a structure of the lifting system by means of one or more sensors, wherein the control unit is configured to apply the length of a structure and/or the angular position of a structure to calculate a path through which the control unit brings the lifting system from the first configuration into the second configuration by using one or more actuators, wherein the path is determined continuously during the operation of the lifting system, wherein the control system is configured for keeping the structures in positions, in which the distance between the struc-

tures and one or more zones and/or positions is larger than a predefined length.

**[0040]** Hereby, it is possible to bring the lifting system of the crane automatically from the first configuration to the second configuration without any action required from the operator in a safer manner. The crane is capable of continuously determining the most optimum path and automatically operate the crane accordingly.

**[0041]** The lifting system comprises a plurality of structures moveably arranged relative to each other. These structures may be a crane base, a column being rotatably attached to the crane base, a jib comprising a number of booms. In a preferred embodiment, the structures may comprise a plurality of booms displaceably arranged with respect to each other. The plurality of booms may preferably be arranged in a telescopically manner with respect to each other.

**[0042]** The lifting system comprises one or more actuators arranged to move the structures relative to each other. The actuators may be of any suitable size and type. In a preferred embodiment, the actuators are formed as hydraulic cylinders.

**[0043]** The control unit enables the operator to select a first configuration by means of the control system comprising the operable control unit.

**[0044]** The first configuration and/or the second configuration may e.g. be selected from a predefined list or may be selected by any indication means e.g. by pointing out a position on a map on a user interface (e.g. a display). The first and/or second configurations may be positions (e.g. lifting positions of a load), it may alternatively be a configuration of a boom/crane arm such as an un-folded configuration of the boom/crane arm or a folded configuration of the boom/crane arm.

**[0045]** It may be an advantage that the first configuration and/or the second configuration is a position of a load being carried by the crane or a position of a structure of the lifting system. This means that the first configuration and/or the second configuration can be defined by the position, at which a load carried by the crane or to be carried by the crane is located.

**[0046]** It may be beneficial that the first configuration and/or the second configuration are selected from a list being visibly available on a user interface. Hereby, the operator can easily select among predefined configurations.

**[0047]** It may be an advantage that the first configuration and/or the second configuration is a position of a load being carried by the crane or a position of a structure of the lifting system. The position may be defined in any suitable coordinate system, e.g. a Cartesian coordinate system, a spherical coordinate system or a polar coordinate system.

**[0048]** It may be advantageous that the crane comprises a user interface, by which it is possible to select the first configuration and/or the second configuration. The use of a user interface makes it easier for the operator to

select the configurations.

**[0049]** In one embodiment, the user interface is configured to allow the user to select a first configuration and a second configuration and a third configuration (that may correspond to the first configuration).

**[0050]** It may be an advantage that the crane comprises a user interface configured to visually display a map, by which it is possible to select the first configuration and/or the second configuration. Hereby, it is possible to make the crane user-friendly. The map may be a one-dimensional map or preferably a two-dimensional map or a three-dimensional map.

**[0051]** It may be an advantage that the control system comprises one or more sensors arranged and configured to detect the distance between the structures and one or more zones and/or positions. Hereby, the distance between the structures and one or more zones and/or positions can be detected.

**[0052]** It may be beneficial that the control system is configured to detect when the distance between the structures and the one or more zones and/or positions is larger than a predefined length.

**[0053]** It may be an advantage that the control unit is configured to automatically stop the actuators when the distance between the structures and one or more zones and/or positions is equal to or smaller than the predefined length. Hereby, the crane can carry out movements of the lifting system and automatically avoid collisions with predefined objects positioned in predefined positions or zones.

**[0054]** The zones and/or positions may be predefined if they are set by default or set by the user/operator of the crane.

**[0055]** The one or the one or more sensors may be a camera, an ultrasonic sensor, a proximity sensor or an optic distance sensor.

**[0056]** It may be advantageous that the control unit comprises an object recognition unit configured to recognise one or more objects of predefined size and/or geometry and/or speed based on data provided by means of a camera. The object recognition unit may comprise a computer-implemented system that may be configurable.

**[0057]** The objects may be moving objects such as a human, an animal or a vehicle.

**[0058]** The control unit is configured to detect the length of a structure of the lifting system and/or an angular position of a structure of the lifting system by means of one or more sensors, wherein the control unit is configured to apply the length of a structure and/or the angular position of a structure to calculate a path, through which the control unit brings the lifting system from the first configuration into the second configuration by using one or more actuators. Hereby, the sensors can provide information sufficient to make sure that all positions of the lifting system are known. Put in other words, the position of the lifting system will be known on a continuous basis.

**[0059]** The path is determined continuously during the

operation of the lifting system. Hereby, it is possible to change the path if this is suitable, e.g. if a moving object is determined or if the control unit determines that another path is desirable. It may be an advantage that the control unit is configured to on a continuous basis look for the most optimum path based on at least one predefined criterion.

**[0060]** The sensors for detecting the length of a structure of the lifting system and/or an angular position of a structure of the lifting system may be any suitable type of sensors including angle sensors and distance sensors.

**[0061]** The term "angular position" may include the angle between adjacent structures and the angle of a structure relative of a predefined orientation (e.g. a vertical or a horizontal axis).

**[0062]** It may be an advantage that the crane is configured to regulate the speed (translation and rotation) of the structures in dependency of the distance between the structures and the one or more zones and/or positions. This may be done by using the control unit of the crane.

**[0063]** A system according to the invention comprises a lorry crane, an external transmitter unit and a receiving unit, wherein the transmitter unit is configured to transmit its position information to the receiving unit.

**[0064]** Hereby, the external transmitter unit can be positioned in a desirable position (e.g. on the ground at an area in which a cargo has to be delivered) and the position of the external transmitter unit can be detected by the receiving unit so that the position of the external transmitter unit can be used as a setting in the control unit. Accordingly, the crane can deliver the cargo in the right position by selecting the said position as the "second configuration of the lifting system".

**[0065]** In one embodiment, the crane comprises a control unit configured to control the lifting system of the crane in such a manner that the crane can perform an automatic loading process that includes loading of a plurality of objects/loads into a predefined area.

**[0066]** In one embodiment, the crane comprises a control unit configured to control the lifting system of the crane in such a manner that the crane can load a truck bed with objects/loads from a stockpile (e.g. on the ground).

**[0067]** In another embodiment, the crane comprises a control unit configured to control the lifting system of the crane in such a manner that the crane can unload a truck bed and place the objects/loads from the truck bed to a predefined area (e.g. a stockpile on the ground).

**[0068]** In one embodiment, the crane comprises a user interface configured to display a setup that allows the operator to select and perform an automatic loading process.

**[0069]** It may be an advantage that the crane comprises visual detection units (e.g. cameras and/or distance sensors) arranged and configured to detect the position and/or orientation of objects/loads to be loaded and/or unloaded (e.g. to a truck bed of a lorry crane). Hereby, it is possible to automatically position the lifting

system of the crane in the correct position in order to lift the objects/loads (e.g. pallets) from their initial position (e.g. in a stockpile). This may be visually illustrated by using a user interface.

**[0070]** It may be beneficial that the crane comprises visual detection units (e.g. cameras and/or distance sensors) that are arranged and configured to detect the position and/or orientation of receiving areas (e.g. of the truck bed or an area on the ground). It is preferred that the crane comprises a control unit configured to receive and determine the position of receiving areas.

**[0071]** The position of receiving areas may be determined on the basis of knowledge of the size and geometry of the objects/loads and area into which the objects/loads have to be placed.

**[0072]** It may be beneficial that the crane comprises a user interface configured to allow the user to select the size and/or geometry of the objects/loads to be carried, so that the control unit can process this information in order to calculate the size and position of the receiving areas.

### Description of the Drawings

**[0073]** The invention will become more fully understood from the detailed description given herein below. The accompanying drawings are given by way of illustration only, and thus, they are not limitative of the present invention. In the accompanying drawings:

Fig. 1A shows a side view of a crane according to the invention having a lifting system arranged in a first configuration;

Fig. 1B shows a side view of the crane shown in Fig. 1A, wherein the lifting system is arranged in a second configuration;

Fig. 1C shows a side view of the crane shown in Fig. 1A, wherein the lifting system is arranged in a third configuration;

Fig. 2A shows a view of a crane according to the invention having a lifting system arranged in a first configuration;

Fig. 2B shows a side view of the crane shown in Fig. 2A, wherein the lifting system is arranged in a second configuration;

Fig. 2C shows a side view of the crane shown in Fig. 2A, wherein the lifting system is arranged in a third configuration;

Fig. 3A shows a view of a crane according to the invention having a lifting system arranged in a first configuration;

Fig. 3B shows a side view of the crane shown in Fig. 3A, wherein the lifting system is arranged in a second configuration;

Fig. 3C shows a side view of the crane shown in Fig. 3A, wherein the lifting system is arranged in a third configuration;

Fig. 3D shows a side view of the crane shown in Fig.

Fig. 4 shows a view of a lifting system of a crane according to the invention and a moving object passing by;

Fig. 5 shows a crane according to the invention and a transmitter unit used to detect the position, in which a load has to be positioned;

Fig. 6A shows a schematic top view of a crane according to the invention having a front end mounted lifting system;

Fig. 6B shows a schematic top view of a crane according to the invention having a front end mounted lifting system;

Fig. 7A shows a view of a display of a user interface according to the invention;

Fig. 7B shows a view of a display of another user interface according to the invention;

Fig. 8 shows an operator applying a user interface according to the invention to control a crane according to the invention;

Fig. 9A shows a view of a crane according to the invention having a lifting system arranged in a first configuration;

Fig. 9B shows a view of the crane shown in Fig. 9A, wherein the lifting system is arranged in another configuration;

Fig. 10A shows a view of a crane according to the invention performing an automatic lifting task comprising the step of loading the truck bed of a lorry;

Fig. 10B shows the crane shown in Fig. 10A, wherein the truck bed has almost been loaded;

Fig. 11A shows a view of a display of a user interface according to the invention, wherein the user interface allows the operator to select and perform an automatic loading process and

Fig. 11B shows a view of the user interface shown in Fig. 11A, when the loading process has been accomplished.

### Detailed description of the invention

**[0074]** Referring now in detail to the drawings for the purpose of illustrating preferred embodiments of the present invention, a crane 2 of the present invention is illustrated in Fig. 1A.

**[0075]** Fig. 1A illustrates a side view of a crane 2 according to the invention comprising a lifting system 28 arranged in a first configuration I. Fig. 1B illustrates a side view of the crane 2 shown in Fig. 1A, wherein the lifting system 28 is arranged in a second configuration II, whereas Fig. 1C illustrates a side view of the crane 2 shown in Fig. 1A, wherein the lifting system 28 is arranged in a third configuration III.

**[0076]** The crane 2 is arranged on a lorry comprising a cab 16 and a truck bed configured to receive and transport objects as the load 12 that is arranged on the cargo

18 positioned in the rear side of the truck bed. A fragile member 20 is arranged in the central portion of the truck bed of the lorry. In Fig. 1A, a zone  $Z_1$  showing an area within a predefined distance to the fragile member 20 is indicated. The distance  $D_1$  from the lifting system 28 to the zone  $Z_1$  is shown. In a preferred embodiment, the invention makes it possible to define the zone  $Z_1$  in such a manner that the structures of the lifting system 28 are kept in positions, in which the distance  $D_1$  between the structures and the zone  $Z_1$  is larger than a predefined length  $L_1$ . The lorry is arranged on the ground G by means of its ground-engaging wheels 52.

**[0077]** The crane 2 comprises a lifting system 28 arranged in a first configuration. The lifting system 28 comprises a crane base 4 fixed to the truck bed, a column 6 protruding from the crane base 4 and a jib 26 rotatably attached to the column 6.

**[0078]** The lifting system 28 comprises an actuator (a hydraulic cylinder) 22 arranged and configured to rotate the jib 26 relative to the column 6. The jib 26 comprises a plurality of telescopic displaceable booms sections 8, 8', 8'', 8'''. The telescopic displaceable booms sections 8, 8', 8'', 8''' are arranged to be displaced relative to each other by means of hydraulic actuators 24 extending along the longitudinal axis of the booms sections 8, 8', 8'', 8'''. A hook 10 is arranged at the distal end of the distal boom section 8'''. In Fig. 1B and Fig. 1C, the hook 10 holds a sling 14 fixed to the load 12. The crane 2 moves the load 12 from its initial position on the top of the cargo 18 (see Fig. 1B) to the ground G (see Fig. 1C).

**[0079]** In Fig. 1A, the lifting system is arranged in a folded configuration. In Fig. 1B, the lifting system 28 has been partly unfolded and the hydraulic actuator 22 has increased the angle between the column 6 and the jib 26. Moreover, the boom of the jib 26 has been partly extended in order to align the hook 10 at the top of the sling 14. In Fig. 1C, the jib 26 has been extended further by means of the hydraulic actuators 24. Furthermore, the angle between the column 6 and the jib 26 has been decreased by using the hydraulic actuator 22.

**[0080]** The crane 2 according to the invention is configured to control and bring the lifting system 28 from a first configuration to a second configuration. This is accomplished by selecting a first configuration and a second configuration by means of a control system comprising an operable control unit (see Fig. 7A, Fig. 7B, Fig. 8, Fig. 9A and Fig. 9B). The control unit is configured to initiate that the actuators 22, 24 brings the lifting system 28 from the first configuration (e.g. the configuration arranged in Fig. 1A) into the second configuration (e.g. the configuration arranged in Fig. 1B) by using one or more of the actuators 22, 24. This means that the operator can bring the lifting system 28 from the first configuration to the second configuration automatically without any manual input required. In one embodiment, the crane is configured to bring the lifting system 28 from an un-folded configuration (as shown in Fig. 1A) to a predefined second configuration. In another embodiment, the crane is

configured to bring the lifting system 28 from a first configuration to the un-folded configuration (as shown in Fig. 1A).

**[0081]** In a preferred embodiment, the crane 2 is configured to bring the lifting system 26 from a first selected configuration to a second selected configuration in a manner in which the lifting system 28 avoids collision with one or more predefined areas or objects (e.g. the fragile member 20). In a preferred embodiment, the crane 2 comprises a control unit configured to select one or more areas or objects that the lifting system 28 and the load 12 carried by it should be kept in a distance from (in order to prevent collision).

**[0082]** Fig. 2A illustrates a view of a crane 2 according to the invention having a lifting system 28 arranged in a first configuration I. Fig. 2B illustrates a side view of the crane 2 shown in Fig. 2A, wherein the lifting system 28 is arranged in a second configuration II. Fig. 2C illustrates a side view of the crane 2 shown in Fig. 2A, wherein the lifting system 28 is arranged in a third configuration III.

**[0083]** The crane 2 is mounted on the rear side of a lorry having a cab 16. A zone  $Z_1$  surrounding the cab 16 is indicated. The zone  $Z_1$  represents a safety zone, from which the lifting system 28 should be kept in a distance exceeding a predefined level so that collision with the cab 16 can be avoided. A zone  $Z_2$  surrounding a fragile member 20 arranged on the truck bed is indicated. This zone  $Z_2$  represents an area, from which the lifting system 28 should be kept in a distance exceeding a predefined level so that collision with the fragile member 20 can be avoided. The crane 2 comprises a control system (not shown) comprising an operable control unit (not shown), by which it is possible to define the position and extension (volume or area) of the zones  $Z_1$ ,  $Z_2$ . The control unit further is configured to be used to define one or more predefined lengths, wherein the control unit controls the actuators 22, 24 in a manner, in which the structures of the lifting system 28 are kept in positions in which the distance between said structures and the zones  $Z_1$ ,  $Z_2$  is larger than the predefined length(s). Hereby, it is possible to avoid collision between the lifting system 28 and objects 16, 20 positioned in said zones  $Z_1$ ,  $Z_2$ . Accordingly, the crane 2 ensures that fragile objects 20, 16 are protected from impacts and contact with the structures of the lifting system 28. The crane 2 comprises outrigger legs 44, 44' arranged to increase the stability (and decrease the risk for tipping) of the crane 2.

**[0084]** The crane 2 comprises a lifting system 28 configured to be arranged in a plurality of configurations I, II, III. The lifting system 28 comprises a plurality of structures: a base 4, a column 6 and a jib 26 comprising a plurality of slidably arranged booms 8, 8', 8'', 8'''. The structures are moveably arranged relative to each other by means of actuators 22, 24 arranged to move the structures relative to each other. The crane 2 is configured to select a first configuration I by means of the control system comprising the operable control unit, select a second configuration II by means of the control unit

and activate the control unit to automatically bring the lifting system 28 from the first configuration I into the second configuration II or from the second configuration II to the third configuration III by using the actuators 22, 24. Thus, the crane 2 makes it possible for the operator to let the crane 2 carry out selected crane tasks automatically.

**[0085]** Fig. 3A illustrates a view of a portion of a crane 2 according to the invention having a lifting system 28 arranged in a first configuration I. Fig. 3B illustrates a side view of the crane 2 shown in Fig. 3A, wherein the lifting system 28 is arranged in a second configuration II. Fig. 3C illustrates a side view of the crane 2 shown in Fig. 3A, wherein the lifting system 28 is arranged in a third configuration III and Fig. 3D illustrates a side view of the crane 2 shown in Fig. 3A, wherein the lifting system 28 is arranged in a fourth configuration IV.

**[0086]** The crane 2 is brought from an unfolded configuration I into a folded configuration IV during the steps shown in Fig. 3A to Fig. 3D. The crane 2 comprises a lifting system comprising a jib 26 rotatably attached to a column 6 that is rotatably attached to a crane base 4. The crane 2 comprises actuators 22, 22', 24 arranged and configured to move structures of the lifting system 28 relative to each other. A hook 10 is arranged in the distal end of the outermost boom of the jib 26.

**[0087]** In a preferred embodiment, the crane 2 and method for controlling the crane 2 is configured to bring the lifting system 28 into the folded configuration IV shown in Fig. 3D. This may be done when the lifting system 28 is arranged in the first configuration I as shown in Fig. 3A, when the lifting system 28 is arranged in the second configuration II as shown in Fig. 3A or when the lifting system 28 is arranged in the third configuration III as shown in Fig. 3C. Hereby, the operator can automatically (without any required operator control action) bring the lifting system 28 into the folded configuration IV shown in Fig. 3D in a simple and user-friendly manner. Besides, collision with objects can automatically be avoided.

**[0088]** The crane 2 and the method for controlling the crane 2 may preferably be configured to automatically bring the lifting system 28 from into any of the configurations I, II, III, IV to any of the configurations I, II, III, IV shown in Fig. 3A, Fig. 3B, Fig. 3C or Fig. 3D.

**[0089]** Fig. 4 illustrates a view of a lifting system 28 of a crane 2 according to the invention and a moving object 36 passing by. The moving object is a running man 36. The lifting system 28 of the crane 2 comprises a jib 26 comprising booms slidably arranged with respect to each other. The jib 26 is rotatably attached to a column 6. The lifting system 28 comprises a number of actuators 22, 24 arranged and configured to move structures of the lifting system 28 relative to each other.

**[0090]** A plurality of cameras 34, 34', 34'', 34''' are provided on the jib 26. The cameras 34, 34', 34'', 34''' are arranged and configured to visually detect objects such as the running man 36. In a preferred embodiment,

the crane 2 comprises a control unit (not shown) comprising an object recognition unit (not shown) configured to recognise one or more objects 36 of predefined size and/or geometry and/or speed based on data provided by means of one or more of the cameras 34, 34', 34'', 34'''. Accordingly, it may be predefined that objects having a volume that exceeds a certain size (e.g. 500 ml, 2000 ml or more) should cause the actuators to stop or move the structures of the lifting system in another direction in order to avoid collision with the object, if these objects are in predefined distance from the structures of the lifting system 28. Furthermore, it may be predefined that objects moving with a speed exceeding a predefined level should cause the actuators to stop or move the structures of the lifting system 28 in another direction in order to avoid collision with the object.

**[0091]** In a preferred embodiment, the crane 2 comprises a control unit configured to stop or move the structures of the lifting system 28 in another direction in order to avoid collision with the object 36 by using the actuators 22, 24, if the distance  $D_1$  between a structure of the lifting system 28 or a load 12 carried by the lifting system 28 is equal to or below a predefined length  $L_1$  as illustrated. Hereby, it is possible to avoid collision with the object 36.

**[0092]** The first camera 34 arranged in the distal end of the jib 26 receives detected signals 38 indicated with dotted lines. Likewise, two of the other cameras 34'', 34''' receives detected signals 38'', 38'''.

**[0093]** Fig. 5 illustrates a crane 2 according to the invention and a transmitter unit 42 used to detect the position, in which a load 12 has to be positioned. The crane 2 comprises a front-mounted lifting system 28 provided on a lorry comprising wheels 52 arranged on the ground. The crane 2 comprises a lifting system 28 comprising a crane base 4, a column 6 rotatably attached to the crane base 4 and a jib 26 rotatably attached to the column 6. The jib 26 comprises a plurality of booms telescopically arranged with respect to each other. The lifting system 28 comprises a hydraulic actuator 22 arranged to rotate the jib 26 relative to the column 6 and another actuator 22' arranged to rotate structures of the jib 26 relative to each other. The jib 26 moreover comprises a hydraulic actuator 24 arranged to displace the telescopically arranged booms with respect to each other.

**[0094]** The lorry comprises a cab 16 that may be selected as a safe zone as default in a preferred embodiment in order to avoid collision of the lifting structure 28 and loads 12 carried by the lifting structure 28 with the cab 16.

**[0095]** The jib 26 comprises a hook 10 mounted in its distal end. The hook 10 carries a load 12. The transmitter unit 42 is arranged at the end of a rod. The transmitter unit 42 transmits signals that are received by a receiving unit 48 connected to the control unit 30 of the crane 2. Accordingly, the transmitter unit 42 can be used to determine the position of the transmitter unit 42 in order to

select the place of delivery. By using the control unit, it is possible to deliver the load 12 in the position marked by means of the transmitter unit 42.

**[0096]** Fig. 6A illustrates a schematic top view of a crane 2 according to the invention having a front end mounted lifting system 28, wherein Fig. 6B illustrates a schematic top view of a crane 2 according to the invention having a front end mounted lifting system 28. Both the crane 2 shown in Fig. 6A and in Fig. 6B is mounted on a lorry having ground-engaging wheels 52 and outrigger legs 44, 44', 46, 46'. The lifting system 28 comprises a jib 26 rotatably attached to a column.

**[0097]** In Fig. 6A, a first zone  $Z_1$  is indicated. It can be seen that when the jib 26 is moved from the first configuration I to the second configuration II, the jib 26 is moved in a path  $P_1$  indicated by a dotted line. In the first configuration II, the distance  $D_1$  between the lifting system 28 (the distal portion of the jib 26) and the zone  $Z_1$  is indicated. As this distance  $D_1$  is larger than the required minimum length  $L_1$  between the lifting system and the zone  $Z_1$ , movement of the jib 26 along the shown path  $P_1$  will not cause the control unit to stop the actuators causing the movement. However, if the distance  $D_1$  would be equal to or smaller than the required minimum length  $L_1$ , the control unit of the crane would stop the actuator(s) (not shown) or cause the actuator(s) to reverse the motion. The distance  $D_1$  may be detected by using any suitable means, e.g. by using sensors detecting the position and/or angle of the structures of the lifting system 28 including the jib 26 and/or sensors configured to determine the position of the zone  $Z_1$ .

**[0098]** In Fig. 6B, a second zone  $Z_2$  is illustrated. It can be seen that when the jib 26 is moved from the first configuration I to the second configuration II, the jib 26 is moved in a path  $P_2$  indicated by a dotted line. In the first configuration II, the distance  $D_2$  between the lifting system 28 (the distal portion of the jib 26) and the zone  $Z_2$  is indicated. As this distance  $D_2$  is larger than the required minimum length  $L_2$  between the lifting system and the zone  $Z_2$ , movement of the jib 26 along the shown path  $P_2$  will not cause the control unit (not shown) to stop the actuators (not shown) causing the movement.

**[0099]** Fig. 7A illustrates a view of a display of a user interface 32 according to the invention, whereas Fig. 7B illustrates a view of a display of another user interface 32 according to the invention.

**[0100]** The user interface 32 shown in Fig. 7A comprises a left column, from which the operator can select a start position (configuration I). The user interface 32 shown in Fig. 7A moreover comprises a right column, from which the operator can select an end position (configuration II). The operator has selected "Position B36" as the first configuration I. "Position B36" may be a default start position or configuration. The operator has selected "Position E12" as the second configuration II. "Position E12" may be a default end position or configuration.

**[0101]** In Fig. 7B, the user interface 32 shows a map with a crane 2 positioned on the street next to a building

50. The operator can select the start configuration I and the end configuration II by using the user interface 32. It can be seen that the operator has selected an end configuration II on the flagstones outside the building 50. Accordingly, the crane 2 enables the operator to bring the load 12 carried by the jib of the crane 2 to move into a position in which the load 12 is delivered on the selected position (configuration II).

**[0102]** The user interface 32 shown in Fig. 7A and in Fig. 7B comprises a start button 54, a pause button 54' and a stop button 54", that the operator can apply if desired. In a preferred embodiment, the use of any of these buttons 54, 54', 54" will "over rule" the control unit.

**[0103]** Fig. 8 illustrates an operator 40 applying a user interface 32 according to the invention to control a crane 2 according to the invention. The crane 2 comprises a lifting system 28 comprising a column 6 and a jib 26 moveably attached to said column 6. The jib 26 comprises a displaceably mounted boom section 8. The lifting system 28 comprises actuators 22, 22', 24 arranged and configured to move structures of the lifting system 28 relative to each other.

**[0104]** By using the user interface 32, the operator 40 is capable of selecting a first configuration (start configuration of the crane 2) and a second configuration (end configuration of the crane 2) and initiate a control system (not shown) of the crane 2 to bring the lifting system 28 of the crane 2 from the first configuration to the second configuration. A hook 10 arranged in the distal end of the boom section 8 is attached to the sling of a load 12. The load 12 is arranged in a distance  $D_2$  from a zone  $Z_2$  surrounding a lamp that is fragile and thus cannot be brought into contact with either the load 12 or the lifting system 28. A predefined minimum "allowable" length  $L_2$  is indicated. The crane 2 is configured to prevent that the load 12 or the lifting system is brought into a distance  $D_2$  that is equal to or shorter than  $L_2$ . Accordingly, collision with the lamp can be avoided.

**[0105]** Fig. 9B illustrates a view of a crane 2 according to the invention having a lifting system 28 arranged in a first configuration I, whereas Fig. 9B illustrates a view of the crane 2 shown in Fig. 9A, wherein the lifting system 28 is arranged in another configuration II.

**[0106]** The crane 2 comprises a lifting system 28 comprising a crane base 4 and a column 6 rotatably attached thereto. A jib 26 is moveably attached to the column 6. The jib 26 comprises displaceably mounted boom sections 8, 8'. The lifting system 28 comprises actuators 22 arranged and configured to move structures of the lifting system 28 relative to each other. A hook 10 is arranged in the distal end of the outermost boom section 8'. A load 12 is carried by the crane 2. The load 12 is attached to the hook 10.

**[0107]** The crane 2 comprises a cab 16 that may be defined as a zone from which the lifting system 28 and the load 12 carried by the lifting system 28 should be kept within a distance exceeding a predefined minimum level. The crane 2 is mounted in the front end of a truck bed of a

lorry having wheels engaging the ground G.

**[0108]** The crane 2 comprises a control unit 30 configured to receive control signals transmitted by a user interface 32 handled by an operator 40. Hereby, the operator 40 can control the crane 2 by selecting a start configuration I and an end configuration II and make the crane 2 move the load 12 from the position shown in Fig. 9A to the position shown in Fig. 9B.

**[0109]** Fig. 10A illustrates a view of a crane 2 according to the invention performing an automatic lifting task comprising the step of loading the truck bed 58 of a lorry. Fig. 10B illustrates the crane 2 shown in Fig. 10A, wherein the truck bed 58 has almost been loaded. The crane 2 basically corresponds to the crane explained with reference to Fig. 9A and Fig. 9B, however, the hook has been replaced by a fork 11 arranged to lift pallets 12' and load the truck bed 58 of the lorry. In Fig. 10A, the pallets 12' are arranged in a stockpile 56 on the ground G next to the lorry. In Fig. 10B, a plurality of the pallets 12' have been moved from the stockpile 56 and are arranged on the truck bed 58 of the lorry.

**[0110]** Fig. 11A illustrates a view of a display of a user interface 32 according to the invention, wherein the user interface 32 allows the operator to select and perform an automatic loading process. Fig. 11B illustrates a view of the user interface 32 shown in Fig. 11A, when the loading process has been accomplished.

**[0111]** The loading process includes loading pallets 12'. The pallets may by way of example contain a building material roof tile, bricks, flagstone. In case the size and geometry of the pallets is predetermined, it is possible to forecast where to arrange the pallets on the truck bed 58. Accordingly, it is possible to carry out an automatic loading process.

**[0112]** In a preferred embodiment, the crane 2 comprises visual detection units (e.g. cameras and/or distance sensors) arranged and configured to detect the position and/or orientation of the pallets 12' to be loaded on the truck bed 58. Hereby, it is possible to automatically position the lifting system of the crane 2 in the correct position in order to lift the pallets from their initial position in a stockpile 56 as indicated in the user interface 32. Moreover, it is preferred that the visual detection units (e.g. cameras and/or distance sensors) are arranged and configured to detect the position and/or orientation of receiving areas 60, 60', 60" on the truck bed 58. It is preferred that the crane 2 comprises a control unit configured to receive and determine the position of receiving areas 60, 60', 60" of the truck bed 58. The position of receiving areas 60, 60', 60" of the truck bed 58 may be determined on the basis of knowledge of the size and geometry of the pallets 12' and the truck bed 58. In Fig. 11A and Fig. 11B, it can be seen that the truck bed 58 is divided into 24 receiving areas 60, 60', 60" indicated by dotted lines. These receiving areas 60, 60', 60" can each receive a pallet 12' of the stockpile 56.

**[0113]** It is preferred that the user interface 32 is configured to allow the user to select the size and/or geo-

metry of the load 12' to be carried, so that the control unit can process this information in order to calculate the size and position of the receiving areas 60, 60', 60". In case the pallets 12' were smaller than the one shown in Fig. 11A and Fig. 11B, the number of the receiving areas 60, 60', 60" may have been higher, whereas the size of the receiving areas 60, 60', 60" may have been smaller.

**[0114]** The operator selects the option "Automatic load of 24 pallets" in the menu and presses the start button 54. Hereafter, the automatic loading process is initiated. The operator hereby defines the start configuration I, as to load pallets 12' from the stockpile 56 and the second configuration II, as to load the truck bed 58.

**[0115]** The operator has the option of pausing the loading process by pressing the pause button 54' or stopping the loading process by pressing the stop button 54".

**[0116]** In Fig. 11B, it can be seen that the user interface 32 reads "Task completed", which indicates that the truck bed 58 has been loaded with pallets 12'. When comparing Fig. 11A and Fig. 11B, it can be seen that a plurality of pallets 12' have been removed from the stockpile 56 and that these pallets 12' have been arranged in the predefined receiving areas 60, 60', 60" of the truck bed 58.

List of reference numerals

#### [0117]

2	Crane
4	Crane base
6	Column
8, 8', 8", 8"', 8'''	Boom section
10	Hook
11	Fork
12, 12'	Load
14	Sling
16	Cab
18	Cargo
20	Fragile member
22, 22'	Actuator
24	Actuator
26	Jib
28	Lifting system
30	Control unit
32	User interface
34, 34', 34", 34'''	Camera
36	Moving object
38, 38", 38'''	Detected signal
40	Operator
42	Transmitter unit
44, 44', 46, 46'	Outrigger leg
48	Receiving unit
50	Building
52	Wheel
54, 54', 54"	Button
56	Stockpile (e.g. brick stockpile)
58	Truck bed

60, 60', 60"	Receiving area
G	Ground
D <sub>1</sub> , D <sub>2</sub>	Distance
L <sub>1</sub> , L <sub>2</sub>	Length
Z <sub>1</sub> , Z <sub>2</sub>	Zone
I, II, III, IV	Configuration
P <sub>1</sub> , P <sub>2</sub>	Path

## Claims

1. A method for controlling a lorry crane (2), having a lifting system (28) configured to be arranged in a plurality of configurations (I, II, III), wherein the lifting system (28) comprises a plurality of structures (6, 10, 22, 24, 26) moveably arranged relative to each other and one or more actuators (22, 24) arranged to move the structures (6, 10, 22, 24, 26) relative to each other, wherein the method comprises the following steps:

- selecting a first configuration (I) among a plurality of configurations by means of a control system comprising an operable control unit (30);
- selecting a second configuration (II) among a plurality of configurations by means of the control unit (30);
- activating the control unit (30) to automatically bringing the lifting system (28) from the first configuration (I) into the second configuration (II) by using one or more actuators (22, 24),

### characterised in that

the method comprises the step of detecting the length of a structure (6, 10, 22, 24, 26) of the lifting system (28) and/or an angular position of a structure (6, 10, 22, 24, 26) of the lifting system (28), wherein the control unit (30) applies the length of a structure (6, 10, 22, 24, 26) and/or the angular position a structure (6, 10, 22, 24, 26) to calculate a path (P<sub>1</sub>, P<sub>2</sub>), through which path (P<sub>1</sub>, P<sub>2</sub>) the control unit (30) brings the lifting system (28) from the first configuration (I) into the second configuration (II) by using one or more actuators (22, 24), wherein the path (P<sub>1</sub>, P<sub>2</sub>) is determined continuously during the operation of the lifting system, wherein the method comprises the step of keeping the structures (6, 10, 22, 24, 26) in positions, in which the distance (D<sub>1</sub>, D<sub>2</sub>) between the structures (6, 10, 22, 24, 26) and one or more zones (Z<sub>1</sub>, Z<sub>2</sub>) and/or positions is larger than a predefined length (L<sub>1</sub>, L<sub>2</sub>, L<sub>3</sub>).

2. A method according to claim 1, **characterised in that** the first configuration (I) and/or the second configuration (II) is a position of a load (12) being carried by the crane (2) or a position of a structure (6,

10, 22, 24, 26) of the lifting system (28).

3. A method according to claim 1 or 2, **characterised in that** the first configuration (I) and/or the second configuration (II) are selected from a list being visibly available on a user interface (32).

4. A method according to claim 1 or 2, **characterised in that** the method comprises the step of selecting the first configuration (I) and/or the second configuration (II) by indicating a position in a map displayed on a user interface (32) or by using an external transmitter unit (42).

5. A method according to one of the preceding claims, **characterised in that** the method comprises the step of automatically stopping the actuators (22, 24) when the distance (D<sub>1</sub>, D<sub>2</sub>) between the structures (6, 10, 22, 24, 26) and the one or more zones (Z<sub>1</sub>, Z<sub>2</sub>) and/or positions is equal to or smaller than the predefined length (L<sub>1</sub>, L<sub>2</sub>).

6. A method according to one of the preceding claims, **characterised in that** the one or more zones (Z<sub>1</sub>, Z<sub>2</sub>) and/or positions are predefined or detected by using one or more sensors.

7. A method according to claim 6, **characterised in that** the one or the one or more sensors is a camera (34, 34', 34", 34'''), an ultrasonic sensor, a proximity sensor or an optic distance sensor.

8. A method according to claim 7, **characterised in that** the control unit (30) comprises an object recognition unit configured to recognise one or more objects of predefined size and/or geometry and/or speed based on data provided by means of a camera (34, 34', 34", 34''').

9. A lorry crane (2) comprising a lifting system (28) configured to be arranged in a plurality of configurations (I, II, III), wherein the lifting system (28) comprises:

- a plurality of structures (6, 10, 22, 24, 26) moveably arranged relative to each other;
  - one or more actuators (22, 24) arranged to move the structures (6, 10, 22, 24, 26) relative to each other,
- wherein the crane (2) comprises a control system comprising an operable control unit (30) configured to:

- select a first configuration (I) among a plurality of configurations;
- select a second configuration (II) among a plurality of configurations by and
- activate the control unit (30) to automati-

cally bringing the lifting system (28) from the first configuration (I) into the second configuration (II) by using one or more actuators (22, 24),

#### characterised in that

the control unit (30) is configured to detect the length of a structure (6, 10, 22, 24, 26) of the lifting system (28) and/or an angular position a structure (6, 10, 22, 24, 26) of the lifting system (28) by means of one or more sensors, wherein the control unit (30) is configured to apply the length of a structure (6, 10, 22, 24, 26) and/or the angular position of a structure (6, 10, 22, 24, 26) to calculate a path ( $P_1$ ,  $P_2$ ) through which the control unit (30) brings the lifting system (28) from the first configuration (I) into the second configuration (II) by using one or more actuators (22, 24), wherein the path ( $P_1$ ,  $P_2$ ) is determined continuously during the operation of the lifting system, wherein the control system is configured for keeping the structures (6, 10, 22, 24, 26) in positions, in which the distance ( $D_1$ ,  $D_2$ ) between the structures (6, 10, 22, 24, 26) and one or more zones ( $Z_1$ ,  $Z_2$ ) and/or positions is larger than a predefined length ( $L_1$ ,  $L_2$ ,  $L_3$ ).

10. A lorry crane (2) according to claim 9, **characterised in that** the crane (2) comprises a user interface (32), by which it is possible to select the first configuration (I) and/or the second configuration (II).

11. A lorry crane (2) according to claim 9 or 10, **characterised in that** the crane (2) comprises a user interface (32) configured to visually display a map, by which it is possible to select the first configuration (I) and/or the second configuration (II).

12. A lorry crane (2) according to one of the claims 9-11, **characterised in that** the control system comprises one or more sensors arranged and configured to detect the distance ( $D_1$ ,  $D_2$ ,  $D_3$ ) between the structures (6, 10, 22, 24, 26) and the one or more zones ( $Z_1$ ,  $Z_2$ ) and/or positions.

13. A lorry crane (2) according to claim 12, **characterised in that** the control unit is configured to automatically stop the actuators (22, 24) when the distance ( $D_1$ ,  $D_2$ ) between the structures (6, 10, 22, 24, 26) and the one or more zones ( $Z_1$ ,  $Z_2$ ) and/or positions is equal to or smaller than a predefined length ( $L_1$ ,  $L_2$ ).

14. A lorry crane (2) according to one of the preceding

claims 9-13, **characterised in that** the control unit (30) comprises an object recognition unit configured to recognise one or more objects of predefined size and/or geometry and/or speed based on data provided by means of a camera (34).

15. A system comprising a lorry crane (2) according to one of the claims 9-14, **characterised in that** the system comprises an external transmitter unit (42) and a receiving unit, wherein the transmitter unit (42) is configured to transmit its position information to the receiving unit (48).

#### Patentansprüche

1. Verfahren zum Steuern eines Fahrzeugkrans (2), der ein Hebesystem (28) aufweist, das konfiguriert ist, um in einer Vielzahl von Konfigurationen (I, II, III) angeordnet zu sein, wobei das Hebesystem (28) eine Vielzahl von Strukturen (6, 10, 22, 24, 26), die relativ zueinander beweglich angeordnet sind, und einen oder mehrere Aktuatoren (22, 24) umfasst, die angeordnet sind, um die Strukturen (6, 10, 22, 24, 26) relativ zueinander zu bewegen, wobei das Verfahren die folgenden Schritte umfasst:

- Auswählen einer ersten Konfiguration (I) aus einer Vielzahl von Konfigurationen mittels eines Steuersystems, das eine betriebsfähige Steuereinheit (30) umfasst;
- Auswählen einer zweiten Konfiguration (II) aus einer Vielzahl von Konfigurationen mittels der Steuereinheit (30);
- Aktivieren der Steuereinheit (30), um das Hebesystem (28) automatisch von der ersten Konfiguration (I) in die zweite Konfiguration (II) zu bringen, indem ein oder mehrere Aktuatoren (22, 24) verwendet werden,

#### dadurch gekennzeichnet, dass

das Verfahren den Schritt des Erfassens der Länge einer Struktur (6, 10, 22, 24, 26) des Hebesystems (28) und/oder einer Winkelposition einer Struktur (6, 10, 22, 24, 26) des Hebesystems (28) umfasst, wobei die Steuereinheit (30) die Länge einer Struktur (6, 10, 22, 24, 26) und/oder die Winkelposition einer Struktur (6, 10, 22, 24, 26) verwendet, um einen Weg ( $P_1$ ,  $P_2$ ) zu berechnen, über welchen Weg ( $P_1$ ,  $P_2$ ) die Steuereinheit (30) das Hebesystem (28) von der ersten Konfiguration (I) in die zweite Konfiguration (II) bringt, indem sie einen oder mehrere Aktuatoren (22, 24) verwendet, wobei der Weg ( $P_1$ ,  $P_2$ ) während des Betriebs des Hebesystems kontinuierlich bestimmt wird, wobei das Verfahren den Schritt des Haltens der

- Strukturen (6, 10, 22, 24, 26) in Positionen umfasst, in denen der Abstand ( $D_1$ ,  $D_2$ ) zwischen den Strukturen (6, 10, 22, 24, 26) und einer oder mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen größer als eine vordefinierte Länge ( $L_1$ ,  $L_2$ ,  $L_3$ ) ist. 5
2. Verfahren nach Anspruch 1, **dadurch gekennzeichnet, dass** die erste Konfiguration (I) und/oder die zweite Konfiguration (II) eine Position einer Last (12), die von dem Kran (2) getragen wird, oder eine Position einer Struktur (6, 10, 22, 24, 26) des Hebeseystems (28) ist. 10
3. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** die erste Konfiguration (I) und/oder die zweite Konfiguration (II) aus einer Liste ausgewählt werden, die auf einer Benutzeroberfläche (32) sichtbar verfügbar ist. 15
4. Verfahren nach Anspruch 1 oder 2, **dadurch gekennzeichnet, dass** das Verfahren den Schritt des Auswählens der ersten Konfiguration (I) und/oder der zweiten Konfiguration (II) durch Angeben einer Position in einer Karte, die auf einer Benutzeroberfläche (32) angezeigt wird, oder durch Verwenden einer externen Sendeeinheit (42) umfasst. 20
5. Verfahren nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** das Verfahren den Schritt des automatischen Anhaltens der Aktuatoren (22, 24) umfasst, wenn der Abstand ( $D_1$ ,  $D_2$ ) zwischen den Strukturen (6, 10, 22, 24, 26) und der einen oder den mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen gleich oder kleiner als die vordefinierte Länge ( $L_1$ ,  $L_2$ ) ist. 25
6. Verfahren nach einem der vorstehenden Ansprüche, **dadurch gekennzeichnet, dass** die eine oder mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen vordefiniert sind oder durch Verwenden eines oder mehrerer Sensoren erfasst werden. 30
7. Verfahren nach Anspruch 6, **dadurch gekennzeichnet, dass** der eine oder der eine oder die mehreren Sensoren eine Kamera (34, 34', 34'', 34'''), ein Ultraschallsensor, ein Näherungssensor oder ein optischer Abstandssensor ist. 35
8. Verfahren nach Anspruch 7, **dadurch gekennzeichnet, dass** die Steuereinheit (30) eine Objekterkennungseinheit umfasst, die konfiguriert ist, um ein oder mehrere Objekte von vordefinierter Größe und/oder Geometrie und/oder Geschwindigkeit basierend auf Daten zu erkennen, die mittels einer Kamera (34, 34', 34'', 34''') bereitgestellt werden. 40
9. Fahrzeugkran (2), umfassend ein Hebeseystem (28), das konfiguriert ist, um in einer Vielzahl von Konfigurationen (I, II, III) angeordnet zu sein, wobei das Hebeseystem (28) umfasst:
- eine Vielzahl von Strukturen (6, 10, 22, 24, 26), die relativ zueinander beweglich angeordnet sind;
  - einen oder mehrere Aktuatoren (22, 24), die angeordnet sind, um die Strukturen (6, 10, 22, 24, 26) relativ zueinander zu bewegen, wobei der Kran (2) ein Steuersystem umfasst, das eine betriebsfähige Steuereinheit (30) umfasst, die konfiguriert ist, um:
- eine erste Konfiguration (I) aus einer Vielzahl von Konfigurationen auszuwählen;
  - eine zweite Konfiguration (II) aus einer Vielzahl von Konfigurationen auszuwählen und
  - die Steuereinheit (30) zu aktivieren, um das Hebeseystem (28) automatisch von der ersten Konfiguration (I) in die zweite Konfiguration (II) zu bringen, indem ein oder mehrere Aktuatoren (22, 24) verwendet werden,
- dadurch gekennzeichnet, dass**
- die Steuereinheit (30) konfiguriert ist, um die Länge einer Struktur (6, 10, 22, 24, 26) des Hebeseystems (28) und/oder eine Winkelposition einer Struktur (6, 10, 22, 24, 26) des Hebeseystems (28) mittels eines oder mehrerer Sensoren zu erfassen, wobei die Steuereinheit (30) konfiguriert ist, um die Länge einer Struktur (6, 10, 22, 24, 26) und/oder die Winkelposition einer Struktur (6, 10, 22, 24, 26) zu verwenden, um einen Weg ( $P_1$ ,  $P_2$ ) zu berechnen, über den die Steuereinheit (30) das Hebeseystem (28) von der ersten Konfiguration (I) in die zweite Konfiguration (II) bringt, indem sie einen oder mehrere Aktuatoren (22, 24) verwendet, wobei der Weg ( $P_1$ ,  $P_2$ ) während des Betriebs des Hebeseystems kontinuierlich bestimmt wird, wobei das Steuersystem konfiguriert ist, um die Strukturen (6, 10, 22, 24, 26) in Positionen zu halten, in denen der Abstand ( $D_1$ ,  $D_2$ ) zwischen den Strukturen (6, 10, 22, 24, 26) und einer oder mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen größer als eine vordefinierte Länge ( $L_1$ ,  $L_2$ ,  $L_3$ ) ist. 45
10. Fahrzeugkran (2) nach Anspruch 9, **dadurch gekennzeichnet, dass** der Kran (2) eine Benutzeroberfläche (32) umfasst, über die es möglich ist, die erste Konfiguration (I) und/oder die zweite Kon-

figuration (II) auszuwählen.

11. Fahrzeugkran (2) nach Anspruch 9 oder 10, **dadurch gekennzeichnet, dass** der Kran (2) eine Benutzeroberfläche (32) umfasst, die konfiguriert ist, um eine Karte visuell anzuzeigen, und über die es möglich ist, die erste Konfiguration (I) und/oder die zweite Konfiguration (II) auszuwählen. 5
12. Fahrzeugkran (2) nach einem der Ansprüche 9-11, **dadurch gekennzeichnet, dass** das Steuersystem einen oder mehrere Sensoren umfasst, die angeordnet und konfiguriert sind, um den Abstand ( $D_1$ ,  $D_2$ ,  $D_3$ ) zwischen den Strukturen (6, 10, 22, 24, 26) und der einen oder den mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen zu erfassen. 10 15
13. Fahrzeugkran (2) nach Anspruch 12, **dadurch gekennzeichnet, dass** die Steuereinheit konfiguriert ist, um die Aktuatoren (22, 24) automatisch anzuhalten, wenn der Abstand ( $D_1$ ,  $D_2$ ) zwischen den Strukturen (6, 10, 22, 24, 26) und der einen oder den mehreren Zonen ( $Z_1$ ,  $Z_2$ ) und/oder Positionen gleich oder kleiner als eine vordefinierte Länge ( $L_1$ ,  $L_2$ ) ist. 20 25
14. Fahrzeugkran (2) nach einem der vorstehenden Ansprüche 9-13, **dadurch gekennzeichnet, dass** die Steuereinheit (30) eine Objekterkennungseinheit umfasst, die konfiguriert ist, um ein oder mehrere Objekte von vordefinierter Größe und/oder Geometrie und/oder Geschwindigkeit basierend auf Daten zu erkennen, die mittels einer Kamera (34) bereitgestellt werden. 30 35
15. System, umfassend einen Fahrzeugkran (2) nach einem der Ansprüche 9-14, **dadurch gekennzeichnet, dass** das System eine externe Sendeeinheit (42) und eine Empfangseinheit umfasst, wobei die Sendeeinheit (42) konfiguriert ist, um ihre Positionsinformationen an die Empfangseinheit (48) zu senden. 40

## Revendications

1. Procédé de commande d'une grue de camion (2), présentant un système de levage (28) configuré pour être disposé dans une pluralité de configurations (I, II, III), dans lequel le système de levage (28) comprend une pluralité de structures (6, 10, 22, 24, 26) disposées de manière mobile les unes par rapport aux autres et un ou plusieurs actionneurs (22, 24) disposés pour déplacer les structures (6, 10, 22, 24, 26) les unes par rapport aux autres, dans lequel le procédé comprend les étapes suivantes : 50 55
  - sélectionner une première configuration (I)

parmi une pluralité de configurations au moyen d'un système de commande comprenant une unité de commande opérationnelle (30) ;  
 - sélectionner une seconde configuration (II) parmi une pluralité de configurations au moyen de l'unité de commande (30) ;  
 - activer l'unité de commande (30) pour amener automatiquement le système de levage (28) de la première configuration (I) à la seconde configuration (II) en utilisant un ou plusieurs actionneurs (22, 24),

## caractérisé en ce que

le procédé comprend l'étape consistant à détecter la longueur d'une structure (6, 10, 22, 24, 26) du système de levage (28) et/ou une position angulaire d'une structure (6, 10, 22, 24, 26) du système de levage (28), dans lequel l'unité de commande (30) applique la longueur d'une structure (6, 10, 22, 24, 26) et/ou la position angulaire d'une structure (6, 10, 22, 24, 26) pour calculer un trajet ( $P_1$ ,  $P_2$ ), trajet ( $P_1$ ,  $P_2$ ) par lequel l'unité de commande (30) amène le système de levage (28) de la première configuration (I) à la seconde configuration (II) en utilisant un ou plusieurs actionneurs (22, 24), dans lequel le trajet ( $P_1$ ,  $P_2$ ) est déterminé en continu pendant le fonctionnement du système de levage, dans lequel le procédé comprend l'étape consistant à maintenir les structures (6, 10, 22, 24, 26) dans des positions, dans lesquelles la distance ( $D_1$ ,  $D_2$ ) entre les structures (6, 10, 22, 24, 26) et une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions est supérieure à une longueur prédéfinie ( $L_1$ ,  $L_2$ ,  $L_3$ ).

2. Procédé selon la revendication 1, **caractérisé en ce que** la première configuration (I) et/ou la seconde configuration (II) est une position d'une charge (12) portée par la grue (2) ou une position d'une structure (6, 10, 22, 24, 26) du système de levage (28).
3. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** la première configuration (I) et/ou la seconde configuration (II) sont sélectionnées dans une liste visiblement disponible sur une interface utilisateur (32). 45
4. Procédé selon la revendication 1 ou 2, **caractérisé en ce que** le procédé comprend l'étape consistant à sélectionner la première configuration (I) et/ou la seconde configuration (II) en indiquant une position sur une carte affichée sur une interface utilisateur (32) ou en utilisant une unité émettrice externe (42). 50 55
5. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** le procédé comprend

- l'étape consistant à arrêter automatiquement les actionneurs (22, 24) lorsque la distance ( $D_1$ ,  $D_2$ ) entre les structures (6, 10, 22, 24, 26) et les une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions est égale ou inférieure à la longueur prédéfinie ( $L_1$ ,  $L_2$ ). 5
6. Procédé selon l'une des revendications précédentes, **caractérisé en ce que** les une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions sont prédéfinies ou détectées à l'aide d'un ou plusieurs capteurs. 10
7. Procédé selon la revendication 6, **caractérisé en ce que** les un ou plusieurs capteurs sont une caméra (34, 34', 34'', 34'''), un capteur à ultrasons, un capteur de proximité ou un capteur de distance optique. 15
8. Procédé selon la revendication 7, **caractérisé en ce que** l'unité de commande (30) comprend une unité de reconnaissance d'objet configurée pour reconnaître un ou plusieurs objets de taille et/ou de géométrie et/ou de vitesse prédéfinies sur la base de données fournies au moyen d'une caméra (34, 34', 34'', 34'''). 20
9. Grue de camion (2) comprenant un système de levage (28) configuré pour être disposé dans une pluralité de configurations (I, II, III), dans laquelle le système de levage (28) comprend : 25
- une pluralité de structures (6, 10, 22, 24, 26) disposées de manière mobile les unes par rapport aux autres ; 30
  - un ou plusieurs actionneurs (22, 24) agencés pour déplacer les structures (6, 10, 22, 24, 26) les unes par rapport aux autres, dans laquelle la grue (2) comprend un système de commande comprenant une unité de commande opérationnelle (30) configurée pour : 35
  - sélectionner une première configuration (I) parmi une pluralité de configurations ; 40
  - sélectionner une seconde configuration (II) parmi une pluralité de configurations et
  - activer l'unité de commande (30) pour amener automatiquement le système de levage (28) de la première configuration (I) à la seconde configuration (II) en utilisant un ou plusieurs actionneurs (22, 24), 45
- caractérisé en ce que** 50
- l'unité de commande (30) est configurée pour détecter la longueur d'une structure (6, 10, 22, 24, 26) du système de levage (28) et/ou une position angulaire d'une structure (6, 10, 22, 24, 26) du système de levage (28) au moyen d'un ou plusieurs capteurs, dans laquelle l'unité de 55
- commande (30) est configurée pour appliquer la longueur d'une structure (6, 10, 22, 24, 26) et/ou la position angulaire d'une structure (6, 10, 22, 24, 26) pour calculer un trajet ( $P_1$ ,  $P_2$ ) à travers lequel l'unité de commande (30) amène le système de levage (28) de la première configuration (I) à la seconde configuration (II) en utilisant un ou plusieurs actionneurs (22, 24), dans laquelle le trajet ( $P_1$ ,  $P_2$ ) est déterminé en continu pendant le fonctionnement du système de levage, dans laquelle le système de commande est configuré pour maintenir les structures (6, 10, 22, 24, 26) dans des positions, dans lesquelles la distance ( $D_1$ ,  $D_2$ ) entre les structures (6, 10, 22, 24, 26) et une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions est supérieure à une longueur prédéfinie ( $L_1$ ,  $L_2$ ,  $L_3$ ).
10. Grue de camion (2) selon la revendication 9, **caractérisée en ce que** la grue (2) comprend une interface utilisateur (32), par laquelle il est possible de sélectionner la première configuration (I) et/ou la seconde configuration (II).
11. Grue de camion (2) selon la revendication 9 ou 10, **caractérisée en ce que** la grue (2) comprend une interface utilisateur (32) configurée pour afficher visuellement une carte, par laquelle il est possible de sélectionner la première configuration (I) et/ou la seconde configuration (II).
12. Grue de camion (2) selon l'une des revendications 9-11, **caractérisée en ce que** le système de commande comprend un ou plusieurs capteurs disposés et configurés pour détecter la distance ( $D_1$ ,  $D_2$ ,  $D_3$ ) entre les structures (6, 10, 22, 24, 26) et les une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions.
13. Grue de camion (2) selon la revendication 12, **caractérisée en ce que** l'unité de commande est configurée pour arrêter automatiquement les actionneurs (22, 24) lorsque la distance ( $D_1$ ,  $D_2$ ) entre les structures (6, 10, 22, 24, 26) et les une ou plusieurs zones ( $Z_1$ ,  $Z_2$ ) et/ou positions est égale ou inférieure à une longueur prédéfinie ( $L_1$ ,  $L_2$ ).
14. Grue de camion (2) selon l'une des revendications 9-13 précédentes, **caractérisée en ce que** l'unité de commande (30) comprend une unité de reconnaissance d'objet configurée pour reconnaître un ou plusieurs objets de taille et/ou de géométrie et/ou de vitesse prédéfinies sur la base de données fournies au moyen d'une caméra (34).
15. Système comprenant une grue de camion (2) selon

l'une des revendications 9-14, **caractérisé en ce que** le système comprend une unité émettrice externe (42) et une unité réceptrice, dans lequel l'unité émettrice (42) est configurée pour transmettre ses informations de position à l'unité réceptrice (48). 5

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Fig. 1A

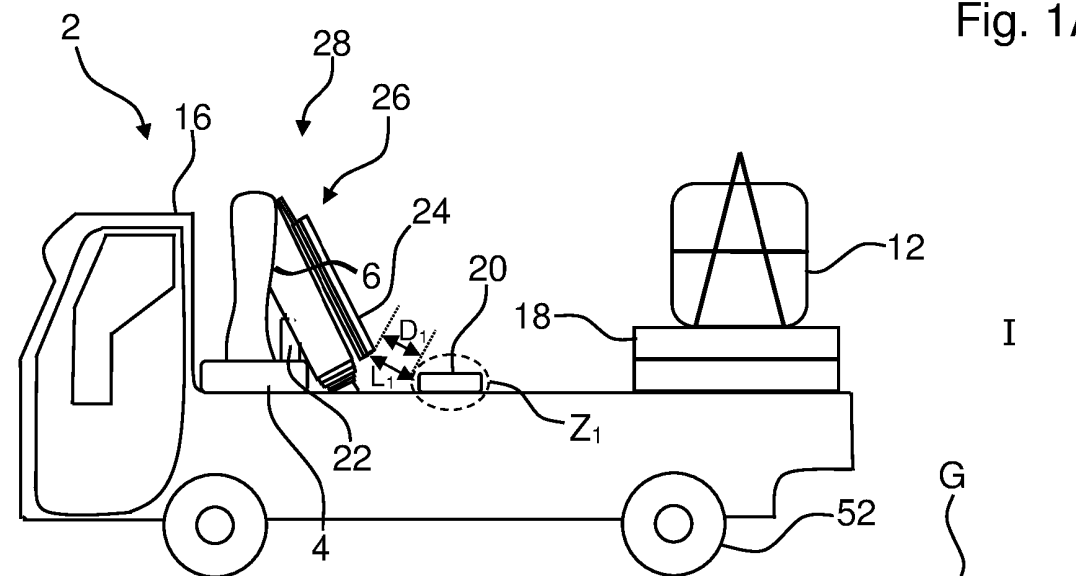


Fig. 1B

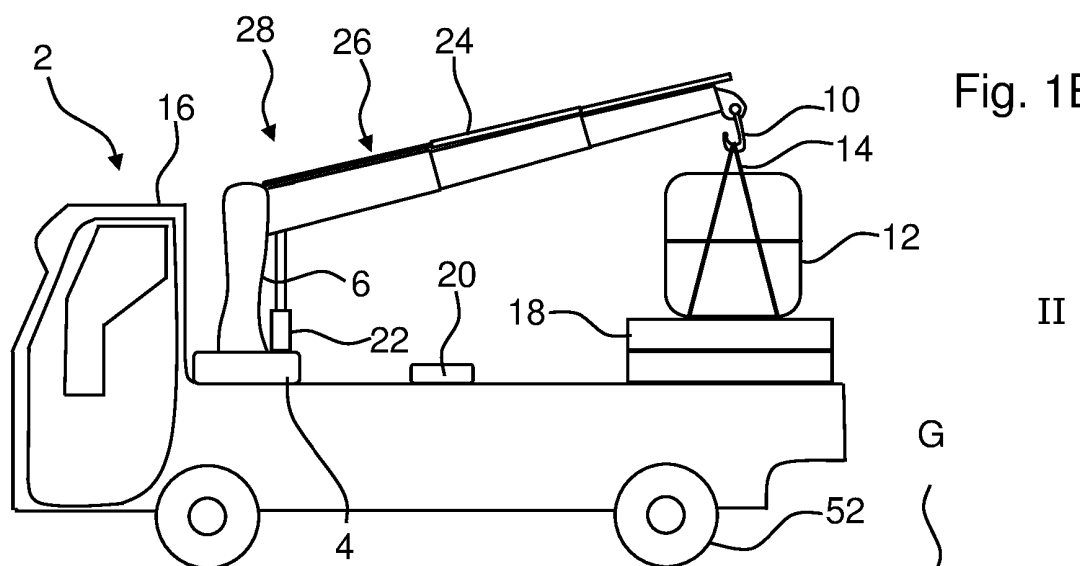
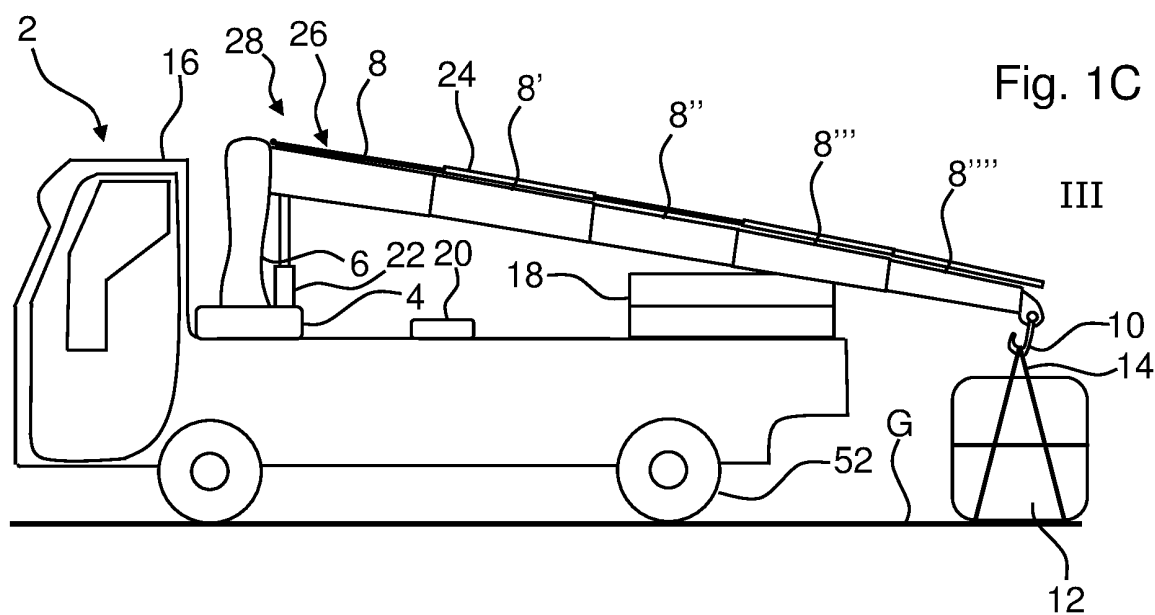


Fig. 1C



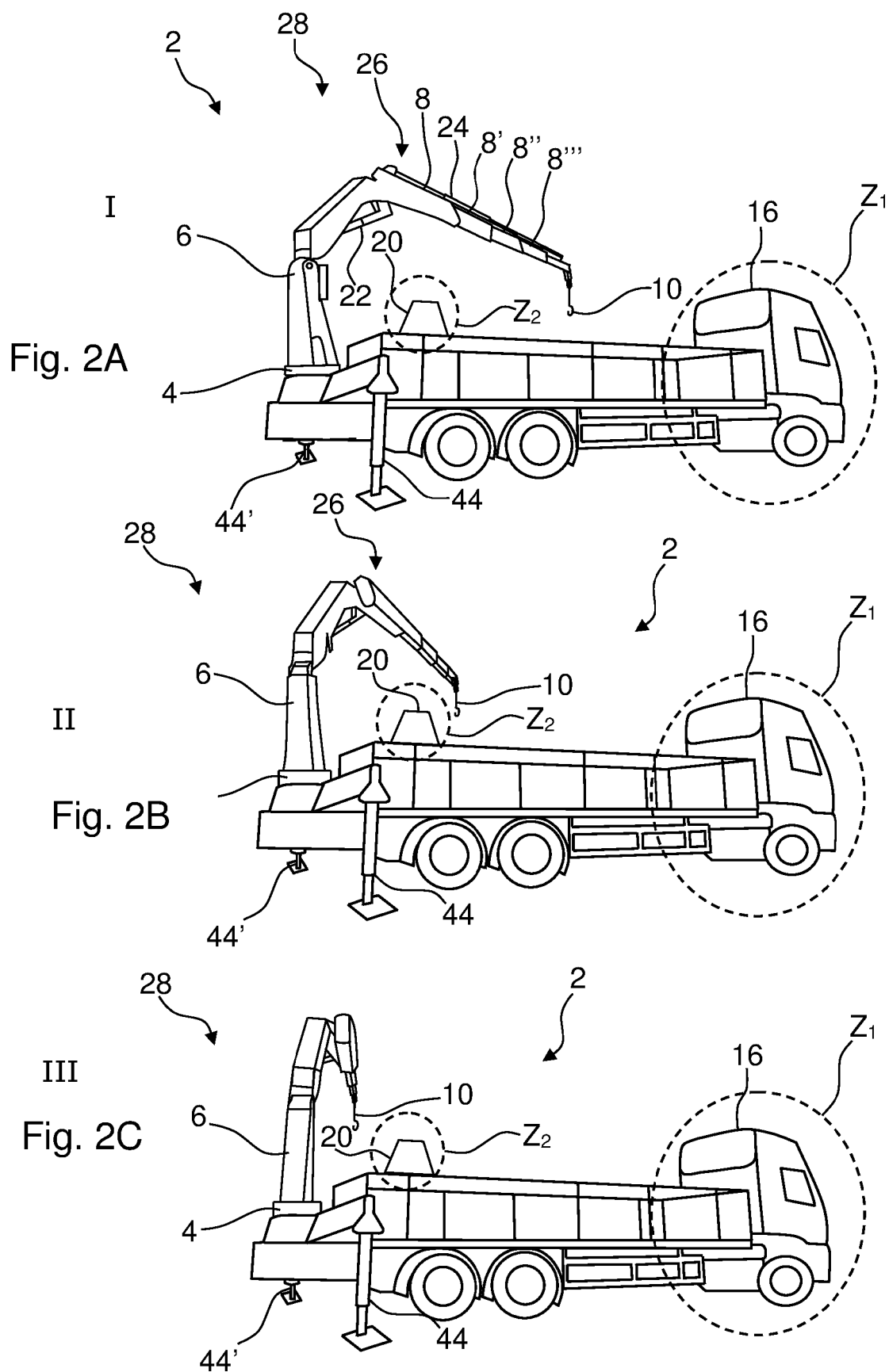


Fig. 3A

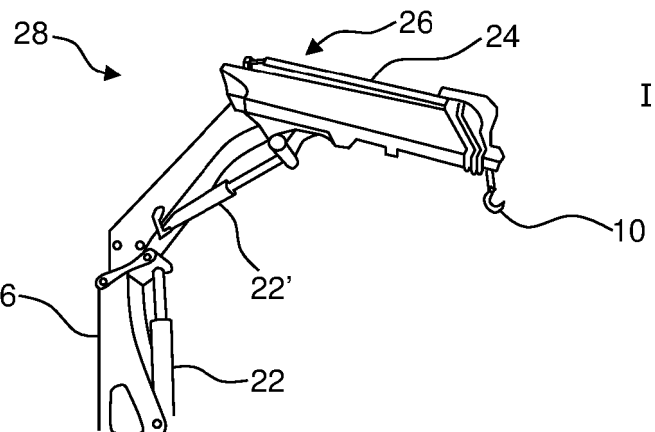


Fig. 3B

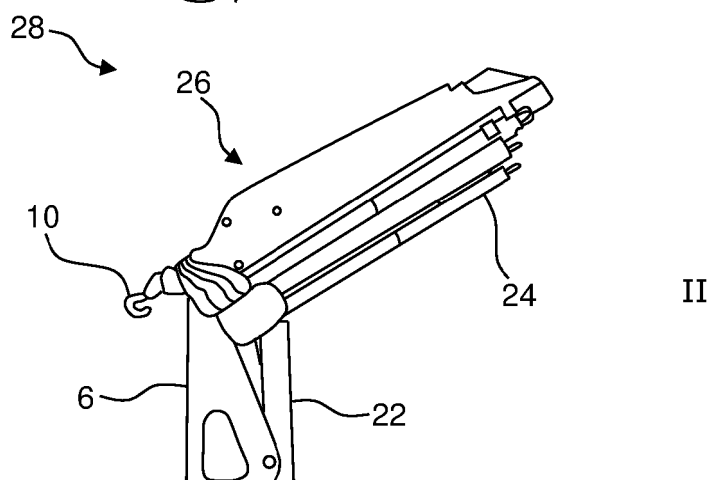


Fig. 3C

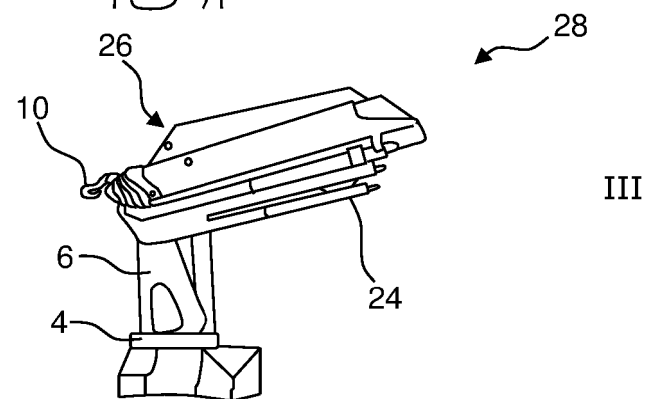


Fig. 3D

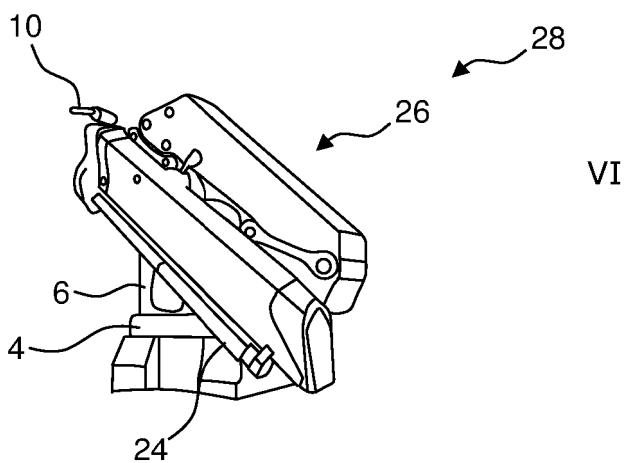
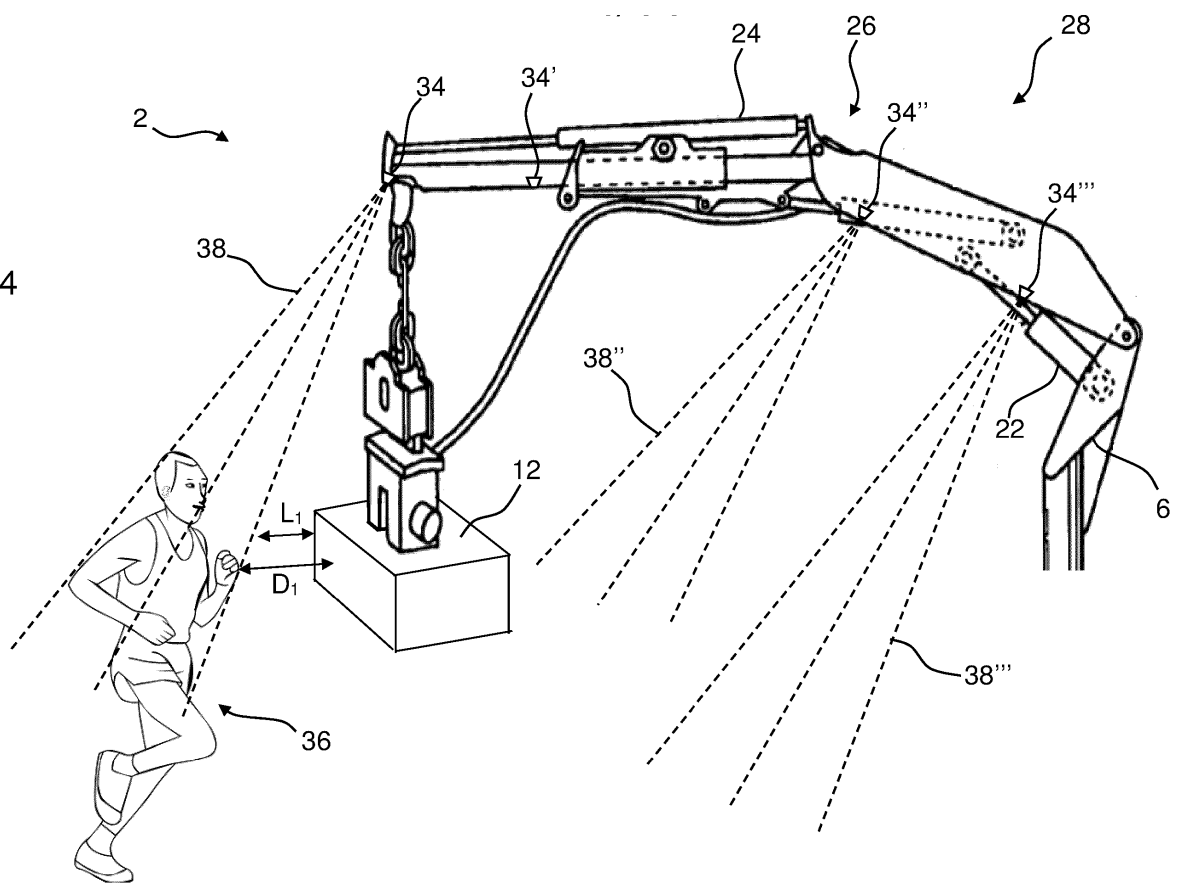
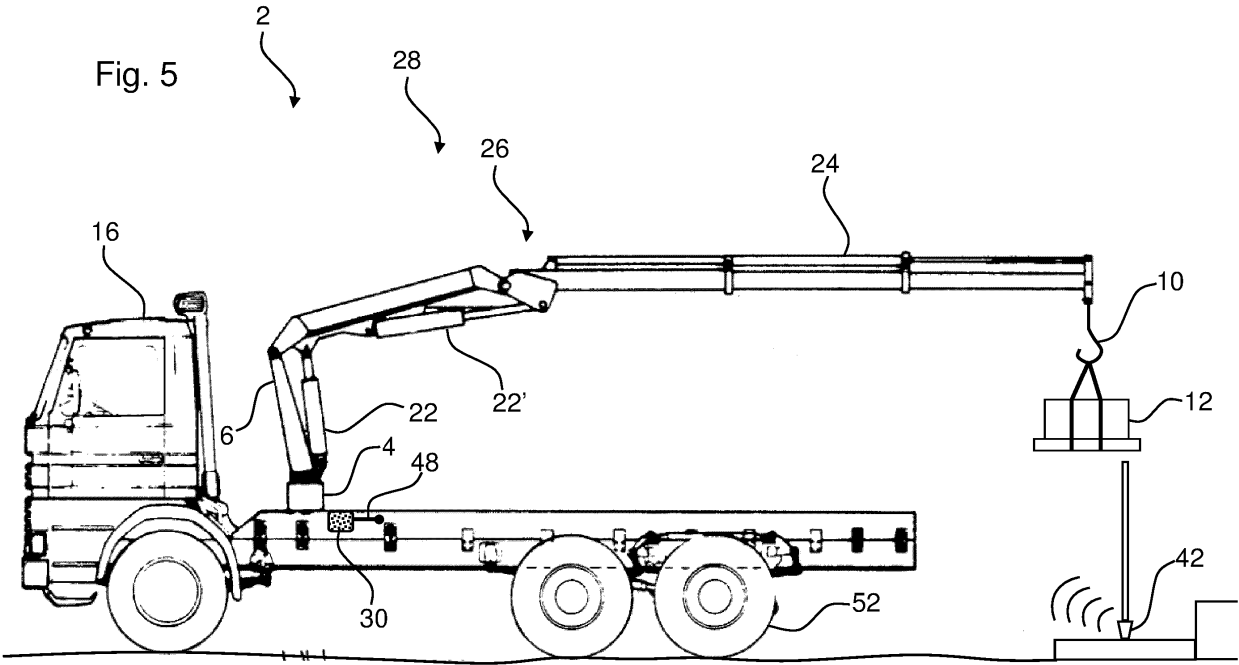
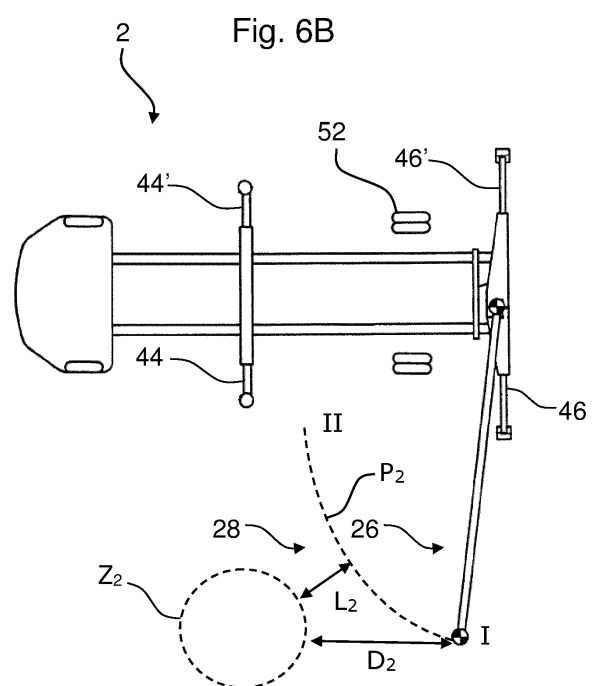
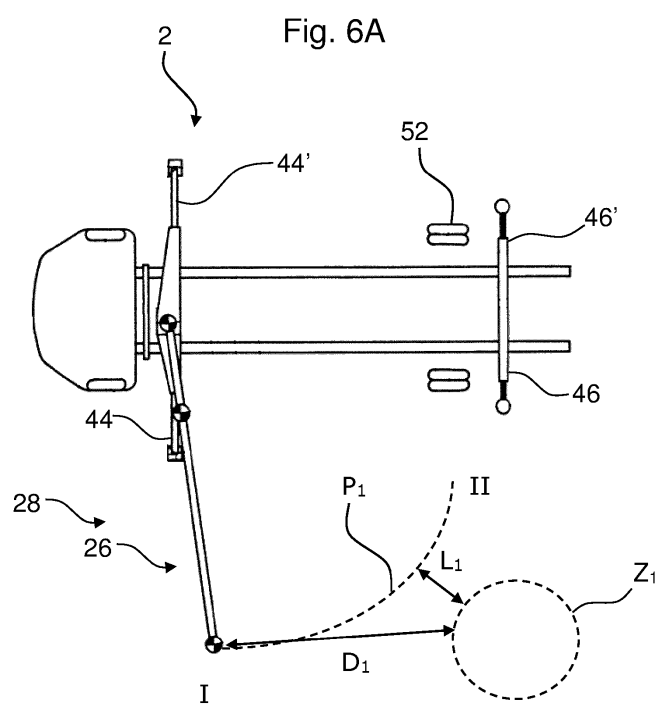
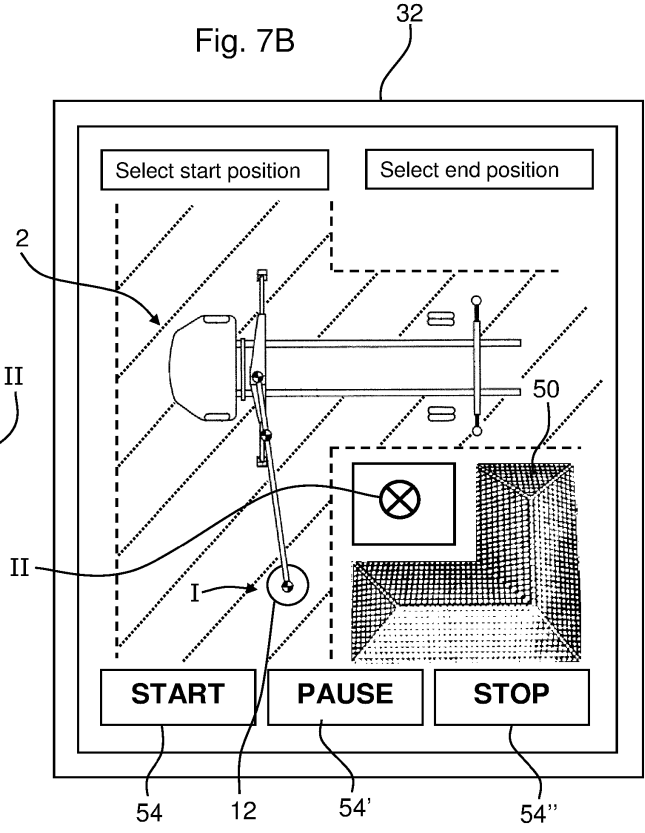
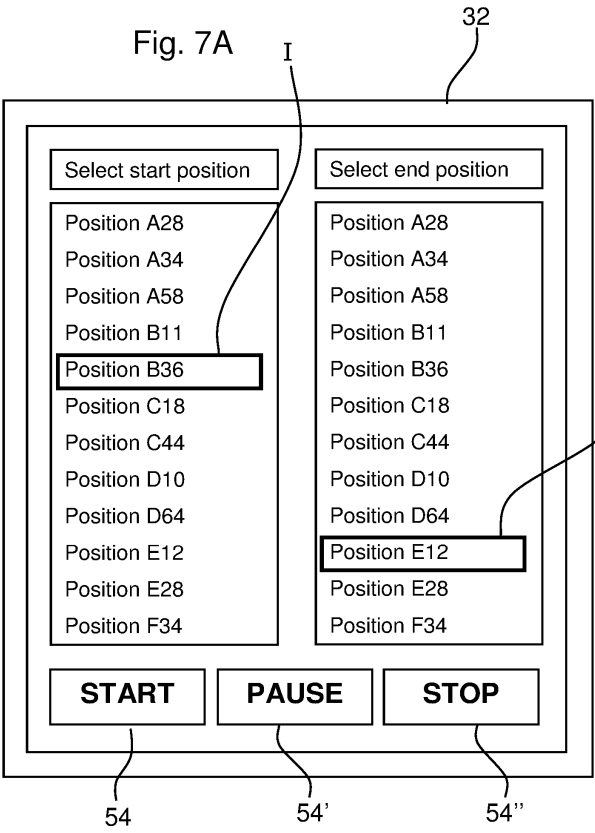


Fig. 4









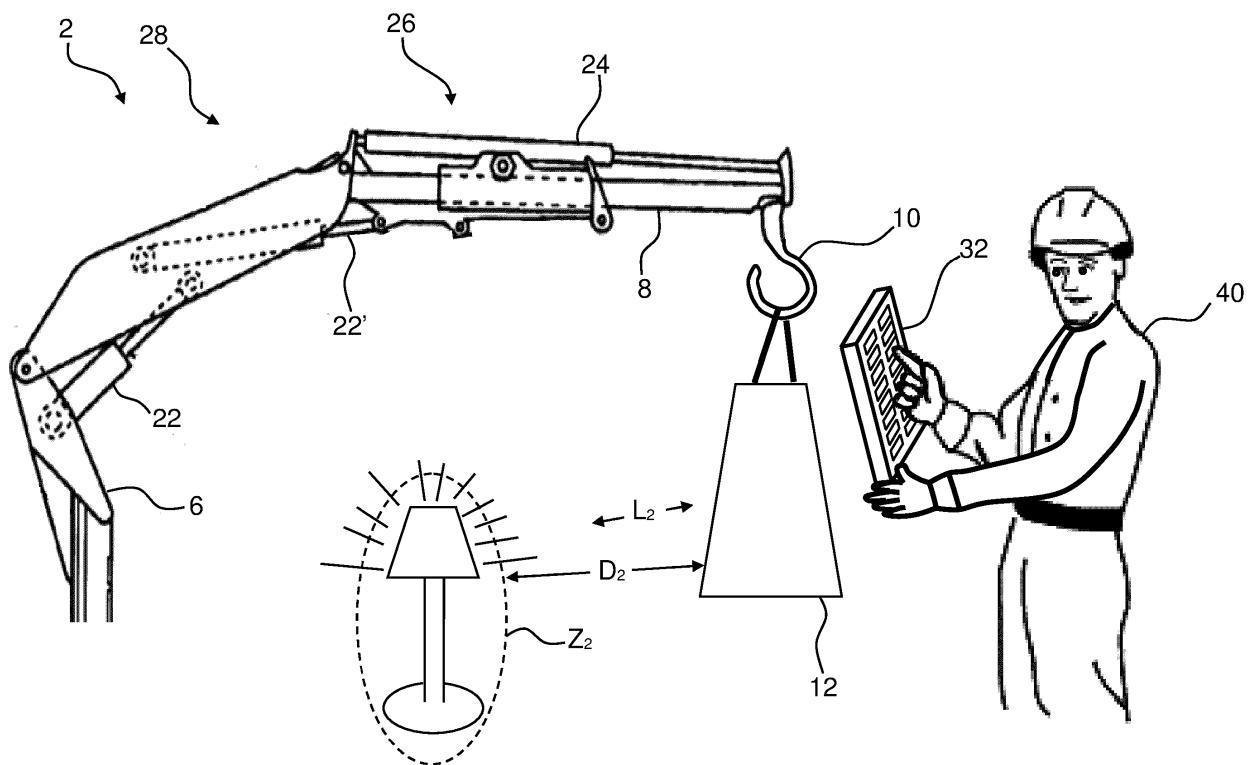
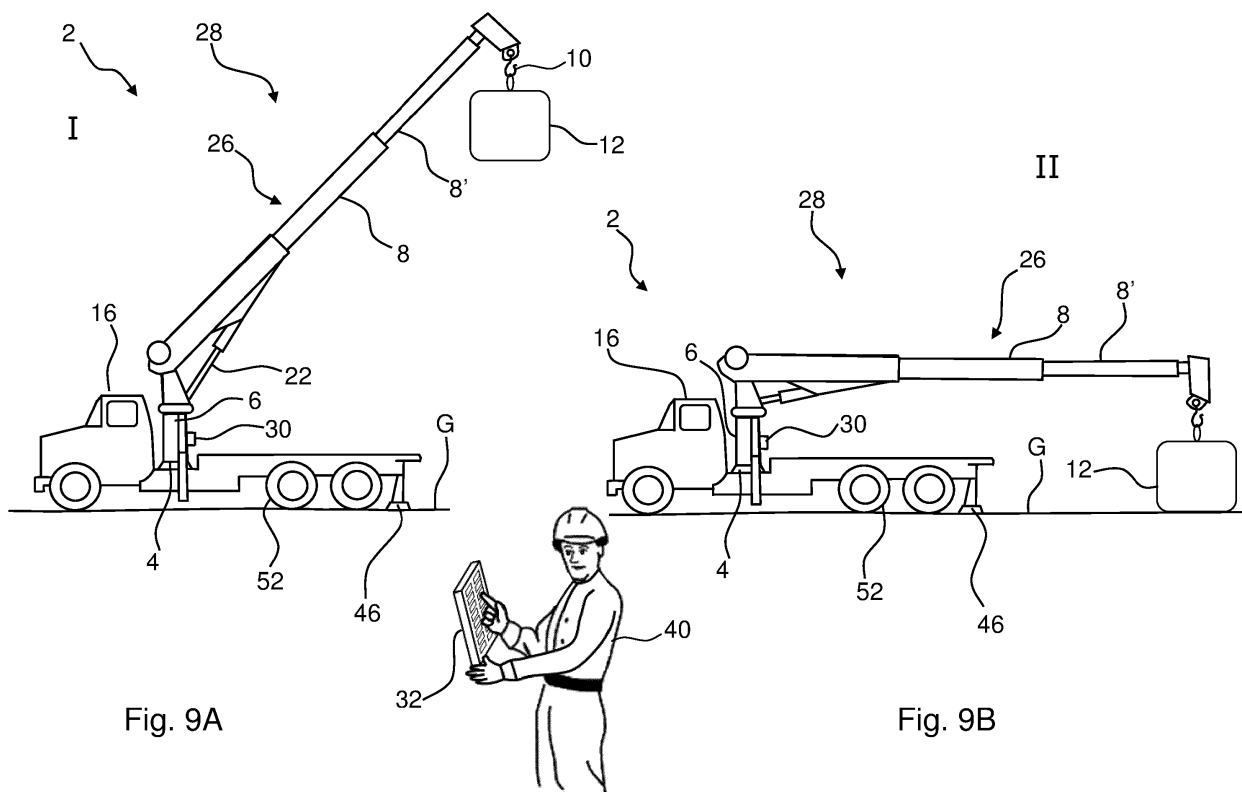


Fig. 8



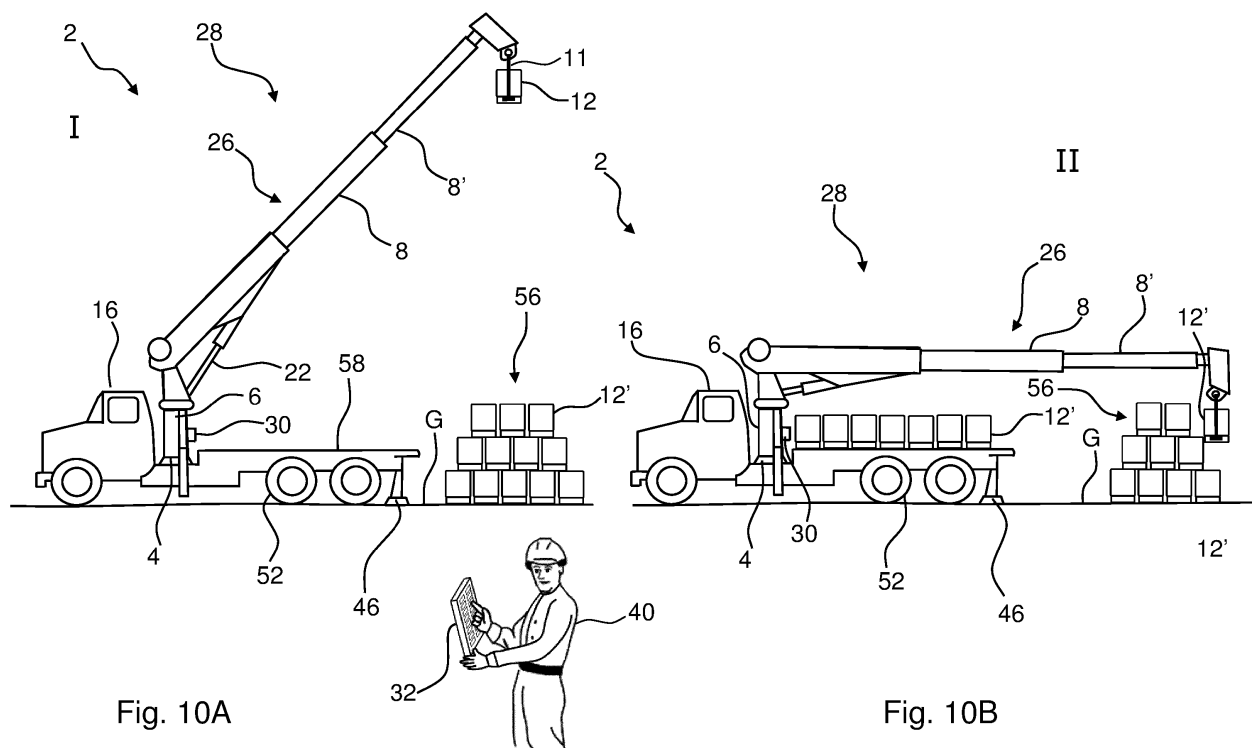


Fig. 11A

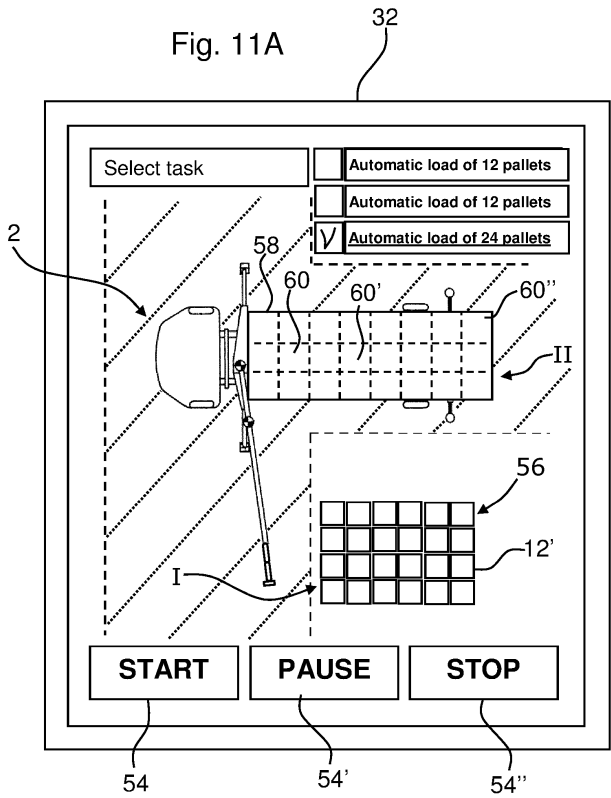
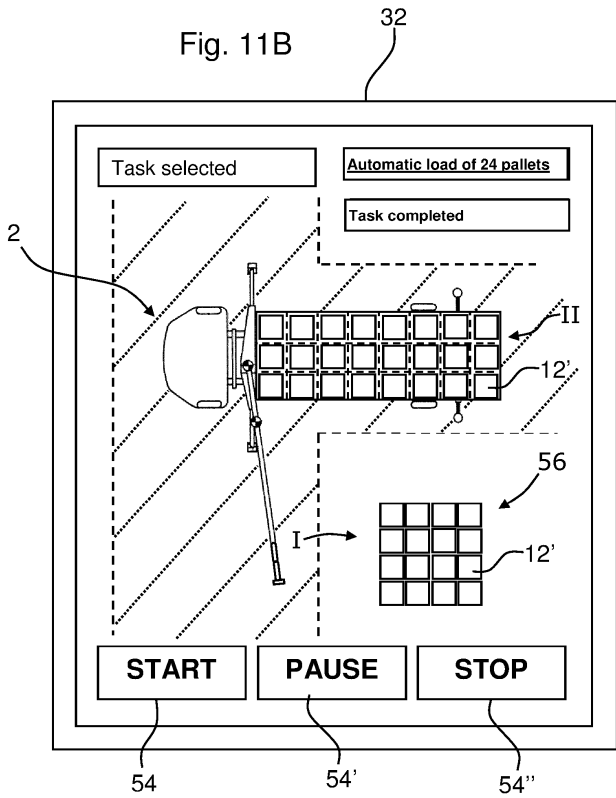


Fig. 11B



**REFERENCES CITED IN THE DESCRIPTION**

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