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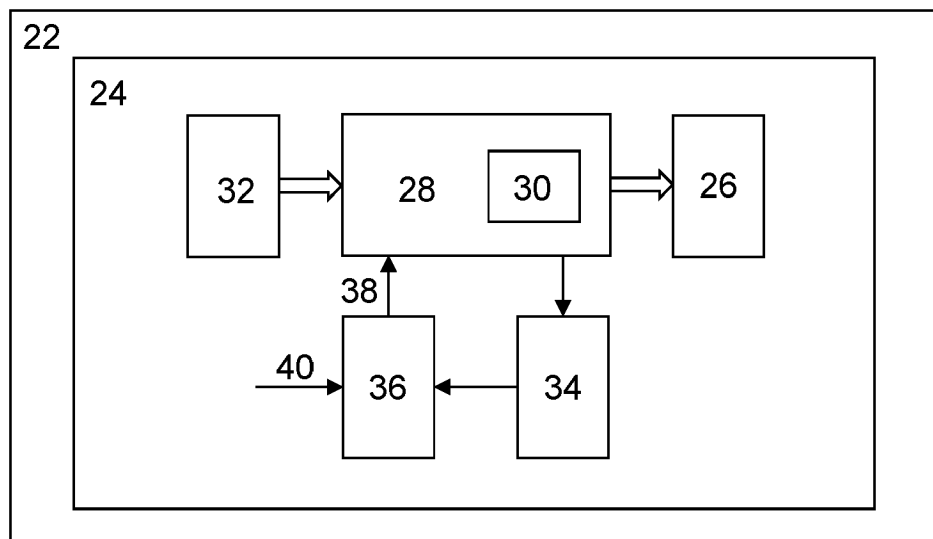
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A CRANE ASSEMBLY SYSTEM
- (57)

A crane assembly (22), comprising:
- a working equipment (24) comprising at least one movable member (26);
- a hydraulic system (28) comprising hydraulic actuators (30) arranged to apply movements to the at least one movable member, the hydraulic actuators being operated by hydraulic fluid discharged from a hydraulic pump (32);
- a system of sensor units (34) for monitoring the hydraulic system (28), and
- a crane assembly control system (36) arranged to generate control instructions (38) to be applied to the system (28) of hydraulic actuators based on a received set of operating instructions (40) defining wanted movements

of the movable member (26). The crane assembly control system (36) is configured to generate said control instructions (38) to perform the wanted movements by activation of one or many of said hydraulic actuators (30) in a movement procedure, wherein said movement procedure comprises performing one sub-procedure or a sequence of many specific sub-procedures of the at least one movable member (26) during the wanted movements. At least one of the sub-procedures has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure, wherein only one specific sub-procedure of a movement procedure is performed at the same time.
- 

```
graph LR
    subgraph 22 [22]
        subgraph 24 [24]
            32[32] --> 28[28]
            28 --> 30[30]
            30 --> 26[26]
        end
        36[36] -- 38 --> 30
        34[34] --> 36
        40[40] --> 36
    end
```
- FIG. 2
- Processed by Luminess, 75001 PARIS (FR)
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Description

Technical field

[0001] The present disclosure relates to a crane assembly, and a method of the crane assembly. In one application the crane assembly is used for improving the automatic or semi-automatic function for parking a crane for transport.

[0002] The crane assembly is specifically related to be applied in loader cranes, which are cranes that are typically mounted on a vehicle (like a truck) and are used for applications in e.g. logistics, waste and recycling, forestry applications. The crane may as an alternative be mounted to another type of host than a vehicle, such as a windmill or similar.

[0003] The loader cranes typically have a predefined parking position which is a stowed and space efficient position suitable for transport, if mounted on a truck. For ease of use, safety during transport and to save time for the crane operator the parking of the crane into this predefined position from a present operation position, when the lifting assignment has finished, may be defined as an automatic or semi-automatic function.

Background

[0004] Solutions for automatically parking a crane (i.e. folding and retracting a crane into a compact state) mounted to a truck are offered today, and have been available for several years.

[0005] During a parking procedure, it is important to make sure that the crane extensions of a telescopic boom system of the crane have been fully retracted to complete the fully automatic sequence for the parking. If one or more of the extensions of the telescopic boom system have not been fully retracted, the crane equipment, truck or persons in the area may be damaged or injured. There are present solutions for either monitoring the distance to the tip of the crane from the main section of the telescopic boom system or to let the crane operator visually inspect and confirm when the extensions have been fully retracted.

[0006] One presently applied solution for automatically confirming that the extensions are retracted is however quite expensive as it requires a rope sensor and is hence not available for all crane models. In another presently applied solution, the automatic sequence stops when the retraction of the extensions needs to be confirmed and the operator is then required to check that the extensions are retracted before restarting the automatic parking. This generates an unwanted and somewhat unintuitive stop in the operating procedure for the crane operator.

[0007] Various related solutions are disclosed in the following documents.

[0008] US10173866B2 discloses a crane controller for a crane, in particular a cargo crane, and is arranged to operate in a first operating mode, in which the crane can

be user-operated by control commands from an operator, and in a second operating mode that can be activated by the operator. In the second operating mode, the crane geometry can be changed by the crane controller in a pre-defined sequence of movements. The crane controller has a user interface, and the interface has a function which can be selected by the operator and by which the crane controller switches from the first to the second operating mode. CN105438986A discloses a crane and a control system for controlling the crane, wherein the control system is configured to automatically extend or retract the crane jib based on an automatic operation mode. The control system is configured to measure properties of crane outriggers, such as outrigger hydraulic pressure and based on the properties, the automatic execution of crane extension or retraction is resumed.

[0009] US 10696524B2 discloses a process for the assisted performance of crane movements by a crane comprising an auxiliary control module which determines at least one target position of the boom system, determines the crane movements necessary for achieving the target position and, after active user confirmation, indirectly or directly activates the specific crane actuators for the performance of the crane movements determined by means of the crane control.

[0010] An object of the present invention is to achieve an improved crane assembly applied to perform various crane movement procedures, e.g. parking of a crane, that does not require operator intervention to be completed, and does not require additional or dedicated sensors, in order to achieve a safe and smooth operation of the movement procedure, and thus is less expensive to apply than presently used solutions.

Summary

[0011] The above-mentioned objects are achieved by the present invention according to the independent claims.

[0012] Preferred embodiments are set forth in the dependent claims.

[0013] The movement procedure, e.g. a parking procedure, comprises a sequence of a sub-procedures and only one movement sub-procedure is activated at the same time.

[0014] The wanted movement procedure is thus known, e.g. it is decided by the system or by the operator which movement procedure to be applied, and then the sequence of sub-procedures making up the movement procedure is known.

[0015] As only one hydraulic movement sub-procedure is active when measurements are made, the pressure variations are solely dependent on the active movement of the crane assembly. It is then possible to use measurement values obtained, e.g. measured close to the hydraulic pump or at any of the supply lines. Thus, no pressure sensor is required to measure the pressure at the specific actuator of extension to be retracted during

parking procedure.

[0016] According to one embodiment where the working equipment is a crane, the technical solution of the crane assembly, and also of the method, defined herein is advantageous, as the semi-automatic/automatic parking sequence of the crane does not need to be stopped for the crane operator to confirm that the boom extension system has been fully retracted. Further, the proposed solution is cost effective, and does not require a dedicated sensor, e.g. a rope sensor, to monitor the length of the boom system.

[0017] Thus, the crane operators will benefit from the present invention, as the parking function will be easier to use and more time efficient to operate.

[0018] It is important to confirm that the boom extensions of a telescopic boom system have been retracted as the semi-automatic or automatic movements may otherwise be a safety problem or limit the available movements of the crane boom system into the parked position. The method for moving the crane into a parked position according to one embodiment of the invention comprises a sequence when the function of retracting the extensions is activated and at the same time monitoring the hydraulic pressure to the hydraulic system of extension cylinders. This hydraulic pressure will increase significantly when all the boom extensions have been fully retracted and by comparing the monitored pressure to a predefined threshold value it can be determined if the boom extensions have been fully retracted or not. The pressure monitoring may be performed by a hydraulic pressure sensor, this pressure sensor may be located in the proximity of the extension cylinders, that are actuating the movements of the extension booms, or alternatively at another location in the hydraulic system.

Brief description of the drawings

[0019]

Figure 1 is a schematic illustration of a basic structure of a crane assembly, mounted on a vehicle, to which the present invention is applicable.

Figure 2 is a block diagram schematically illustrating the present invention.

Figure 3 is a time graph schematically illustrating hydraulic pressure of sub-procedures.

Figure 4 is a flow diagram illustrating the present invention.

Detailed description

[0020] The crane assembly, a vehicle, and the method of the crane assembly, will now be described in detail with references to the appended figures. Throughout the figures the same, or similar, items have the same reference signs. Moreover, the items and the figures are not necessarily to scale, emphasis instead being placed upon illustrating the principles of the invention.

[0021] First with references to figure 1, which is a schematic illustration of a vehicle from behind provided with a crane assembly according to one embodiment of the present invention. The crane assembly typically comprises a crane base mounted to the vehicle, and comprising a crane slewing house 6. A column 7 is rotatably mounted to the crane slewing house 6 so as to be rotatable in relation to the crane base about an essentially vertical axis of rotation A1 by an actuator 8 for rotating the column 7 in relation to the crane slewing house 6.

[0022] Stabilizers 5 and a stabilizer beam 2 are further included in the crane base; the stabilizers may be extended from the stabilizer beam 2 using one or more stabilizer extension booms. The stabilizer beam 2 may be welded, bolted, integrated and/or otherwise connected to the crane slewing house 6 to which the crane column 7 is arranged. The design and manufacturing of the crane base parts could hence be adapted in various way depending on the size and model of the crane.

[0023] The crane has further a crane boom system 10 comprising a first and a second liftable and lowerable crane boom 11, 13 which are articulately connected to each other and actuators 12, 14, for lifting and lowering the crane booms 11, 13, wherein a first crane boom 11 of the crane boom system is articulately connected to the column 7, and the second crane boom 13 of the crane boom system is articulately connected to the first crane boom 11. Additional booms, such as telescopic booms (e.g. crane jibs) or fixed booms (e.g. a manual extension boom) may further be added to the crane boom system 10, e.g. a telescopic boom extension may be operated by an actuator 15. The column 7, and the crane boom system 10 together form part of a movable member of the crane. The end of crane boom 13 is in the illustrated example provided with a crane tip 42 where a hook is arranged.

[0024] Crane boom 13 is in figure 1 illustrated as a telescopic boom system with a main section, an extension boom and an extension cylinder 15 operating the extending and retracting movement of the boom extension. Although the telescopic boom system of figure 1 only illustrates one single extension boom, the invention may be applied to crane assemblies with telescopic booms comprising a plurality of boom extensions.

[0025] The actuators 12, 14, 15 of the crane boom system is arranged to be operated by hydraulic fluid with a hydraulic flow. The hydraulic fluid being discharged from a hydraulic pump at a working pressure and wherein the hydraulic actuators are further arranged to apply movements to the movable member.

[0026] A sensor system comprising sensor units 34 is configured to monitor positions of the crane boom system, and operating conditions of the actuators 8, 12, 14, 15 and to generate sensor signals in response to the monitored positions and operating conditions. The sensor system may comprise angle sensors for monitoring the angle of the booms e.g. in relation to the boom or column that they are attached to, sensors for monitoring

the slewing angle of the column, pressure sensors measuring the hydraulic pressure in hydraulic cylinders, sensors for measuring how far the boom extensions have been extended, etc.

[0027] A crane assembly control system 36 is further part of the crane assembly for e.g. controlling the actuators 8, 12, 14 of the crane, to thereby control the rotation of the column 7 and the positioning of the crane booms 11, 13 on the basis of control instructions 38 in response to operating instructions 40 received over a control interface and the generated sensor signals. The control system 36 and the control instructions 38 are schematically shown in figure 1, and the control system 36 may be any processing entity provided with necessary circuitry required to generate the control instructions. As an example, it may be an integrated part of a control system of the vehicle or be a separate unit arranged on the crane assembly. Operating instructions 40 may e.g. be received from a manoeuvring unit operated by a crane operator. The crane operator may operate the crane remotely or from the site where the crane performs a working assignment. As an alternative, the control system may receive control instructions at the control interface from an autonomous crane control unit.

[0028] Figure 2 is a block diagram schematically illustrating the crane assembly according to the present invention.

[0029] A crane assembly 22 is provided, comprising a working equipment 24, e.g. a crane of the type shown in figure 1, comprising at least one movable member 26, e.g. the first and second crane booms 11, 13 shown in figure 1, or another crane arm comprising a telescopic boom system.

[0030] The crane assembly further comprises a hydraulic system 28 comprising hydraulic actuators 30 (denoted 8, 11, 14, 15 in the embodiment illustrated in figure 1) arranged to apply movements to the at least one movable member 26. The hydraulic actuators being operated by hydraulic fluid discharged from a hydraulic pump 32. The crane assembly also comprises a system of sensor units 34 for monitoring the hydraulic system 28. In figure 2, block arrows indicate hydraulic fluid supplied from the hydraulic pump to the hydraulic system, and further to apply movements to the at least one movable member. A crane assembly control system 36 is arranged to generate control instructions 38 to be applied to the system 28 of hydraulic actuators based on a received set of operating instructions 40, e.g. input by an operator via a maneuvering unit, defining wanted movements of the at least one movable member 26.

[0031] The crane assembly control system 36 is configured to generate the control instructions 38 to perform the wanted movements by activation of one or many of the hydraulic actuators 30 in a movement procedure. The movement procedure comprises performing one sub-procedure or a sequence of many specific sub-procedures of the at least one moveable member 26 during the wanted movements.

[0032] One exemplary movement procedure is to move a crane from a working position where the one or many feed booms are fully extended, or at least partially extended, to a parking position where the crane is folded.

[0033] At least one of the sub-procedures of a movement procedure has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure, wherein only one specific sub-procedure of a movement procedure is performed at the same time.

[0034] The crane assembly control system 36 is further configured to:

- receive and determine the hydraulic pressure of the hydraulic system 28 involved for performing a crane assembly movement procedure;
- determine and obtain a pressure signal characteristic having a predetermined time period length of the determined hydraulic pressure, i.e. the pressure signal characteristic is obtained during a moving time measurement window having said predetermined time period length;
- compare a determined pressure signal characteristic to a set of one or many predefined pressure signal characteristic(s) associated to the one or many sub-procedure(s) of the current movement procedure having an associated pressure signal characteristic, and
- determine, as a result of the comparison, if an obtained pressure signal characteristic is identified in the set of pressure signal characteristics.

[0035] If a pressure signal characteristic is identified the crane assembly control system 36 is further configured to:

- determine that the identified pressure signal characteristic is associated to the present movement procedure;
- determine the sub-procedure associated with the identified pressure signal characteristic, and
- secure that the sub-procedure associated to the present movement procedure has been completed, and if that is secured, continue the movement procedure.

[0036] As an illustrating example a movement procedure being a crane parking procedure will be discussed in detail with references to figure 3. The movement procedure comprises in this case four sub-procedures SP1-SP4, to be performed sequentially during the parking procedure. In figure 3 shows the variation over time T of schematically illustrated measured hydraulic pressures P.

[0037] The sequence of movements may be predetermined, for example by first retracting all extensions (SP1), then folding the second boom of the crane (SP2)

and then slewing the semi-folded crane in the right direction towards the parked position (SP3) before finishing the folding of the first boom of the crane (SP4).

[0038] During SP1, when the boom extension reaches its retracted position, the hydraulic pressure increases due to that the movement caused by the hydraulic actuator suddenly stops as the end position is reached. This hydraulic pressure increase is thus a clear indication that the end position has been reached. The predefined pressure signal characteristic may then be that the hydraulic pressure is higher than a preset pressure threshold during a preset time period which is a clear indication that sub-procedure SP1 has been completed. In figure 3, in order to visually illustrate one way of identifying completion of a sub-procedure, the preset time period and the preset pressure threshold is schematically indicated by a detection window DW, whereas a sub-procedure is considered completed when the pressure signal lies within the DW.

[0039] The same methodology may similarly be applied to sub-procedures SP2, SP3 and SP4 if there are predefined pressure signal characteristics for identifying the completion of these sub-procedures. In the illustrated example a set of predefined pressure signal characteristics is provided where each signal characteristic is uniquely associated to a sub-procedure of the current movement procedure. Thus, each movement procedure has an associated set of pressure signal characteristics. The sub-procedure and corresponding predefined pressure signal characteristics that is relevant to be identified in the obtained pressure signal characteristics may be determined from the which sub-procedure that is currently being performed by the crane assembly.

[0040] As stated above, at least one of the sub-procedures of a movement procedure has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure. In cases where not all sub-procedures of a movement procedure have an associated predefined hydraulic pressure signal characteristic, the completion of the other sub-procedures, i.e. those not having a predefined pressure signal characteristics, are then determined by using one or many sensor units 34 of the sensor system to determine that a sub-procedure has been completed. Suitable sensor units 34 may then be sensors to verify positions, e.g. angle sensors, and/or sensors applicable to continuously monitor positions and/or movements, e.g. image capturing sensors.

[0041] According to one embodiment, the working equipment 24 comprises a crane base and a movable member 26 connected to the crane base, the movable member comprising a rotatable column 7, a first boom 11 pivotally attached to the column 7, a second boom 13 pivotally attached to the first boom 11 and optionally further booms, wherein at least one of the booms of the movable arm is a telescopic boom with one or more boom extensions. This embodiment is illustrated in figures 1

and 2.

[0042] In another embodiment, one movement procedure is a crane parking procedure, and one sub-procedure of the crane parking procedure is a retraction of a telescopic boom extension until fully retracted.

[0043] In this embodiment the movement procedure comprises a sequence of sub-procedures where retracting the extension system is the sole sub-procedure that is activated and that e.g. a control valve inlet port pressure from the pump is monitored and compared to a predefined threshold value to determine if all the telescopic boom extensions have been retracted. A hydraulic pressure sensor that is already available in the hydraulic system and is further used for another purpose may then be used for monitoring the inlet pressure for this purpose as well. As an example, a hydraulic pressure sensor that normally is used for dump monitoring may be used for this purpose.

[0044] The pressure input from the pressure sensor may be monitored in comparison to the predefined pressure threshold so that it is further required that the pressure level is above the threshold during a defined time period. This requirement may make the crane assembly according to the invention less sensitive to other factors in the operation environment. As an example, the pressure needed to retract the extensions may increase with colder temperatures, and there might further be other factors that might cause temporary pressure spikes.

[0045] In a further embodiment, the working equipment comprises at least one supporting leg 5 (also denoted stabilizer 5) structured to be activated and applied to ground for stabilizing purposes. One movement procedure is a stabilizer parking procedure including sub-procedures comprising e.g. lifting the stabilizer from ground, and withdrawing the stabilizer beam into a withdrawn position.

[0046] According to another embodiment, the sensor unit 34 applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is arranged to measure the hydraulic pressure supplied to the hydraulic actuator arranged to apply movement to the movable member 26.

[0047] According to still another embodiment, the sensor unit 34 applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is arranged to measure the hydraulic pressure from the hydraulic pump.

[0048] According to a further embodiment, the sensor unit 34 applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is not arranged for specifically measure the hydraulic pressure of the hydraulic actuator arranged to apply movement to the presently moved at least one movable member 26.

[0049] According to another embodiment, one of the predefined pressure signal characteristics is that the hydraulic pressure is higher than a preset pressure threshold during a preset time period, wherein said preset pres-

sure value is a fixed value, or a predetermined portion of a maximal pressure value.

[0050] Preferably, the predetermined time period length is in the interval greater than 0 and less than 2 seconds.

[0051] In one variation, one of the predefined pressure signal characteristics is that the absolute value of the derivate of the hydraulic pressure curve is higher than a preset value.

[0052] According to the invention, a vehicle is provided that comprises a crane assembly as defined herein.

[0053] Advantageously, the crane assembly is arranged to operate in one of a group of operation modes. The group of operation modes comprises a manual mode wherein the received set of operating instructions are received from a maneuvering unit operated by a crane operator and an automatic movement mode, wherein the received set of operating instructions are received from an automatic operation unit, and wherein the various movement procedures are applicable when the crane assembly is operated in the automatic operation mode.

[0054] The control system 16 may be configured to control the pressure level of the hydraulic fluid discharged from the hydraulic pump such that the pressure level is at its maximal level less than a predetermined portion of a movement procedure, where the predetermined portion is preferably 10%.

[0055] The present invention also relates to a method of a crane assembly 22. The crane assembly has been described in detail above and it is herein referred to that description. The method will now be described with references to the flow diagram shown in figure 3.

[0056] Thus, the crane assembly comprises:

- A working equipment 24 comprising at least one movable member 26.
- A hydraulic system 28 comprising hydraulic actuators 30 arranged to apply movements to the at least one movable member, the hydraulic actuators being operated by hydraulic fluid discharged from a hydraulic pump 32.
- A system of sensor units 34 for monitoring the hydraulic system 28.
- A crane assembly control system 36 arranged to generate control instructions 38 to be applied to the system 28 of hydraulic actuators based on a received set of operating instructions 40 defining wanted movements of the movable member 26, wherein the crane assembly control system 36 is configured to generate said control instructions 38 to perform the wanted movements by activation of one or many of said hydraulic actuators 30 in a movement procedure, wherein said movement procedure comprises performing one sub-procedure or a sequence of many specific sub-procedures of the at least one moveable member 26 during the wanted movements.

[0057] At least one of the sub-procedures of a movement procedure has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure, wherein only one specific sub-procedure of a movement procedure is performed at the same time.

[0058] The method comprises:

- Receiving and determining the hydraulic pressure of the hydraulic system 28 involved for performing a crane assembly movement procedure.
- Determining and obtaining a pressure signal characteristic having a predetermined time period length of the determined hydraulic pressure, i.e. said pressure signal characteristic is obtained during a moving time measurement window having said predetermined time period length.
- Comparing a determined pressure signal characteristic to a set of one or many predefined pressure signal characteristic(s) associated to the one or many sub-procedure(s) of the current movement procedure having an associated pressure signal characteristic.
- Determining, as a result of said comparison, if an obtained pressure signal characteristic is identified in said set of pressure signal characteristics. If a pressure signal characteristic is identified, the method further comprises:
 - Determining that the identified pressure signal characteristic is associated to the present movement procedure.
 - Determining the sub-procedure associated with the identified pressure signal characteristic.
 - Securing that the sub-procedure associated to the present movement procedure has been completed, and if that is secured, continuing the movement procedure.

[0059] In the following, some embodiments of the method are listed. These have the same technical features and advantages as for the corresponding features of the crane described above. Consequently, these technical features and advantages are not repeated or explained anew in order to avoid unnecessary repetition.

[0060] According to one embodiment, the movement procedure is a crane parking procedure, and one sub-procedure of the crane parking procedure is a retraction of a telescopic boom extension until fully retracted.

[0061] According to another embodiment, the sensor unit 34 applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is arranged to measure the hydraulic pressure supplied to the hydraulic actuator arranged to apply movement the movable member 26, or is arranged to measure the hydraulic pressure from the hydraulic pump.

[0062] According to still another embodiment, the sensor unit 26 applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is not arranged for specifically measure the hydraulic pressure of the hydraulic actuator arranged to apply movement to the presently moved at least one movable member 26.

[0063] In another embodiment, one of the predefined pressure signal characteristics is that the hydraulic pressure is higher than a preset pressure threshold during a preset time period, wherein the preset pressure value is a fixed value, or a predetermined portion of a maximal pressure value.

[0064] In a further variation, one of the predefined pressure signal characteristics is that the absolute value of the derivate of the hydraulic pressure curve is higher than a preset value. The present invention is not limited to the above-described preferred embodiments. Various alternatives, modifications and equivalents may be used. Therefore, the above embodiments should not be taken as limiting the scope of the invention, which is defined by the appending claims.

Claims

1. A crane assembly (22), comprising:

- a working equipment (24) comprising at least one movable member (26);
- a hydraulic system (28) comprising hydraulic actuators (30) arranged to apply movements to the at least one movable member, the hydraulic actuators being operated by hydraulic fluid discharged from a hydraulic pump (32);
- a system of sensor units (34) for monitoring the hydraulic system (28), and
- a crane assembly control system (36) arranged to generate control instructions (38) to be applied to the system (28) of hydraulic actuators based on a received set of operating instructions (40) defining wanted movements of the movable member (26), wherein the crane assembly control system (36) is configured to generate said control instructions (38) to perform the wanted movements by activation of one or many of said hydraulic actuators (30) in a movement procedure, wherein said movement procedure comprises performing one sub-procedure or a sequence of many specific sub-procedures of the at least one moveable member (26) during the wanted movements, **characterized in that** at least one of the sub-procedures has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure, wherein only one specific sub-procedure of a movement

procedure is performed at the same time, the crane assembly control system (36) is further configured to:

- receive and determine the hydraulic pressure of the hydraulic system (28) involved for performing a crane assembly movement procedure;
- determine and obtain a pressure signal characteristic having a predetermined time period length of the determined hydraulic pressure;
- compare a determined pressure signal characteristic to a set of one or many predefined pressure signal characteristic(s) associated to the one or many sub-procedure(s) of the current movement procedure having an associated pressure signal characteristic, and
- determine, as a result of said comparison, if an obtained pressure signal characteristic is identified in said set of pressure signal characteristics, and if a pressure signal characteristic is identified, the crane assembly control system (36) is further configured to:
 - determine that the identified pressure signal characteristic is associated to the present movement procedure;
 - determine the sub-procedure associated with the identified pressure signal characteristic, and
 - secure that the sub-procedure associated to the present movement procedure has been completed, and if that is secured, continue the movement procedure.

2. The crane assembly (22) according to claim 1, wherein said working equipment (24) comprises a crane base (6) and a movable member (26) connected to the crane base, the movable member comprising a rotatable column (7), a first boom (11) pivotally attached to the column (7), a second boom (13) pivotally attached to the first boom (11) and optionally further booms, wherein at least one of the booms of the movable arm is a telescopic boom.

3. The crane assembly (2) according to claim 2, wherein one movement procedure is a crane parking procedure, and one sub-procedure, having an associated predefined hydraulic pressure signal characteristic, of the crane parking procedure is a retraction of a telescopic boom extension until fully retracted.

4. The crane assembly (2) according to claim 1, wherein said working equipment comprises at least one supporting leg structured to be activated and applied to ground for stabilizing purposes.

5. The crane assembly (2) according to any of claims 1-4, wherein the sensor unit (34) applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement pro-

cedure is arranged to measure the hydraulic pressure supplied to the hydraulic actuator arranged to apply movement to the movable member (26).

6. The crane assembly (2) according to any of claims 1-5, wherein the sensor unit (34) applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is arranged to measure the hydraulic pressure from the hydraulic pump. 5
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7. The crane assembly (2) according to any of claims 1-6, wherein the sensor unit (34) applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is not arranged for specifically measure the hydraulic pressure of the hydraulic actuator arranged to apply movement to the presently moved at least one movable member (26). 15
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8. The crane assembly (2) according to any of claims 1-7, wherein one of said predefined pressure signal characteristics is that the hydraulic pressure is higher than a preset pressure threshold during a preset time period, wherein said preset pressure value is a fixed value, or a predetermined portion of a maximal pressure value. 25
9. The crane assembly (2) according to any of claims 1-8, wherein said predetermined time period length is in the interval greater than 0 and less than 2 seconds. 30
10. A vehicle comprising a crane assembly according to any of claims 1-9. 35
11. A method of a crane assembly (22), the crane assembly comprises:
 - a working equipment (24) comprising at least one movable member (26); 40
 - a hydraulic system (28) comprising hydraulic actuators (30) arranged to apply movements to the at least one movable member, the hydraulic actuators being operated by hydraulic fluid discharged from a hydraulic pump (32); 45
 - a system of sensor units (34) for monitoring the hydraulic system (28), and
 - a crane assembly control system (36) arranged to generate control instructions (38) to be applied to the system (28) of hydraulic actuators based on a received set of operating instructions (40) defining wanted movements of the movable member (26), wherein the crane assembly control system (36) is configured to generate said control instructions (38) to perform the wanted movements by activation of one or many of said hydraulic actuators (30) in a movement procedure. 50
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cedure, wherein said movement procedure comprises performing one sub-procedure or a sequence of many specific sub-procedures of the at least one moveable member (26) during the wanted movements, **characterized in that** at least one of the sub-procedures has an associated predefined hydraulic pressure signal characteristic, and completion of all sub-procedures of a movement procedure is a presumption for completing the movement procedure, wherein only one specific sub-procedure of a movement procedure is performed at the same time, the method comprises:

- receiving and determining the hydraulic pressure of the hydraulic system (28) involved for performing a crane assembly movement procedure;
 - determining and obtaining a pressure signal characteristic having a predetermined time period length of the determined hydraulic pressure;
 - comparing a determined pressure signal characteristic to a set of one or many predefined pressure signal characteristic(s) associated to the one or many sub-procedure(s) of the current movement procedure having an associated pressure signal characteristic, and
 - determining, as a result of said comparison, if an obtained pressure signal characteristic is identified in said set of pressure signal characteristics, and if a pressure signal characteristic is identified, the method further comprises:
 - determining that the identified pressure signal characteristic is associated to the present movement procedure;
 - determining the sub-procedure associated with the identified pressure signal characteristic, and
 - securing that the sub-procedure associated to the present movement procedure has been completed, and if that is secured, continuing the movement procedure.
12. The method according to claim 11, wherein one movement procedure is a crane parking procedure, and one sub-procedure, having an associated predefined hydraulic pressure signal characteristic, of the crane parking procedure is a retraction of a telescopic boom extension until fully retracted.
 13. The method according to claim 11 or 12, wherein the sensor unit (34) applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is arranged to measure the hydraulic pressure supplied

to the hydraulic actuator arranged to apply movement the movable member (26), or is arranged to measure the hydraulic pressure from the hydraulic pump.

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14. The method according to any of claims 11-13, wherein the sensor unit (26) applied to receive, and determine the hydraulic pressure of the hydraulic system involved for performing a movement procedure is not arranged for specifically measure the hydraulic pressure of the hydraulic actuator arranged to apply movement to the presently moved at least one movable member (26).

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15. The method according to any of claims 11-14, wherein one of said predefined pressure signal characteristics is that the hydraulic pressure is higher than a preset pressure threshold during a preset time period, wherein said preset pressure value is a fixed value, or a predetermined portion of a maximal pressure value.

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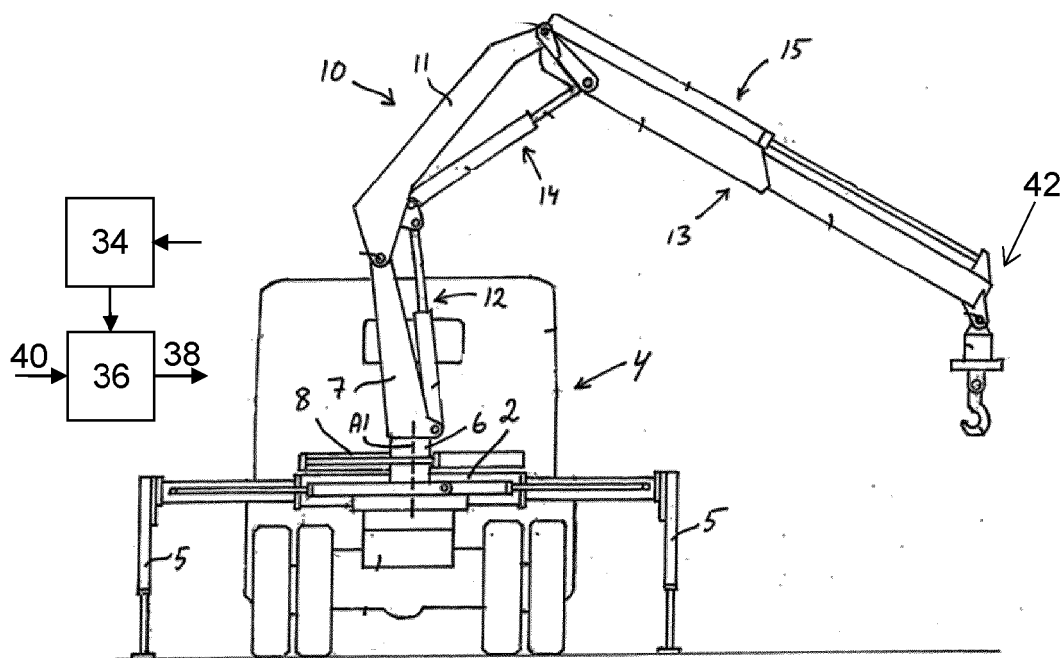


FIG. 1

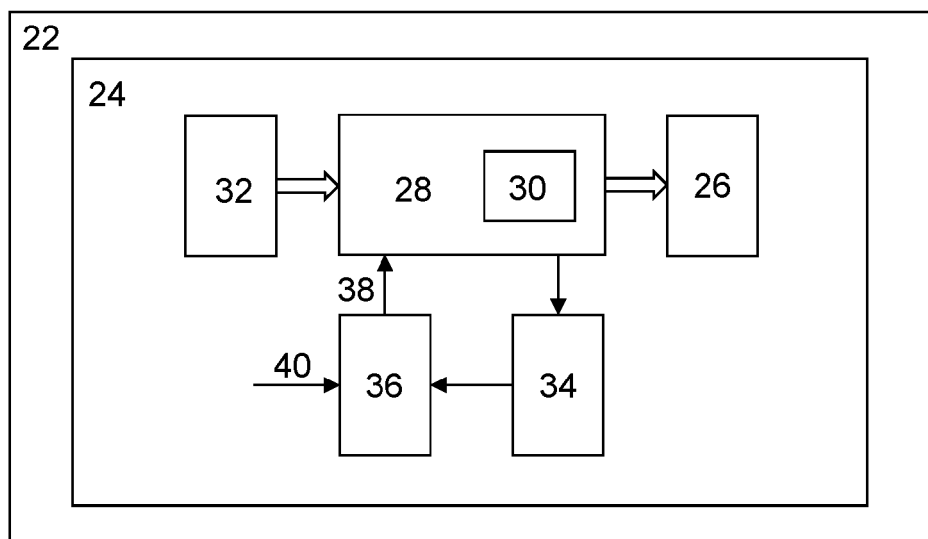


FIG. 2

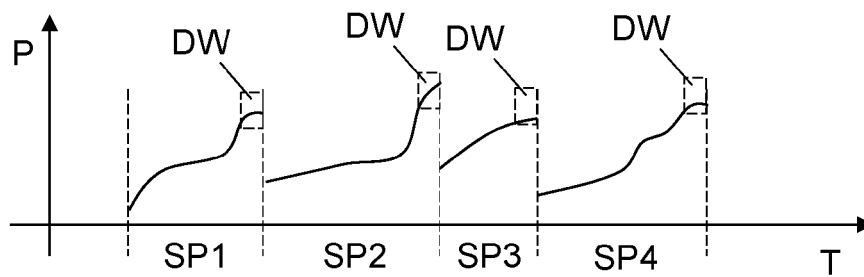


FIG. 3

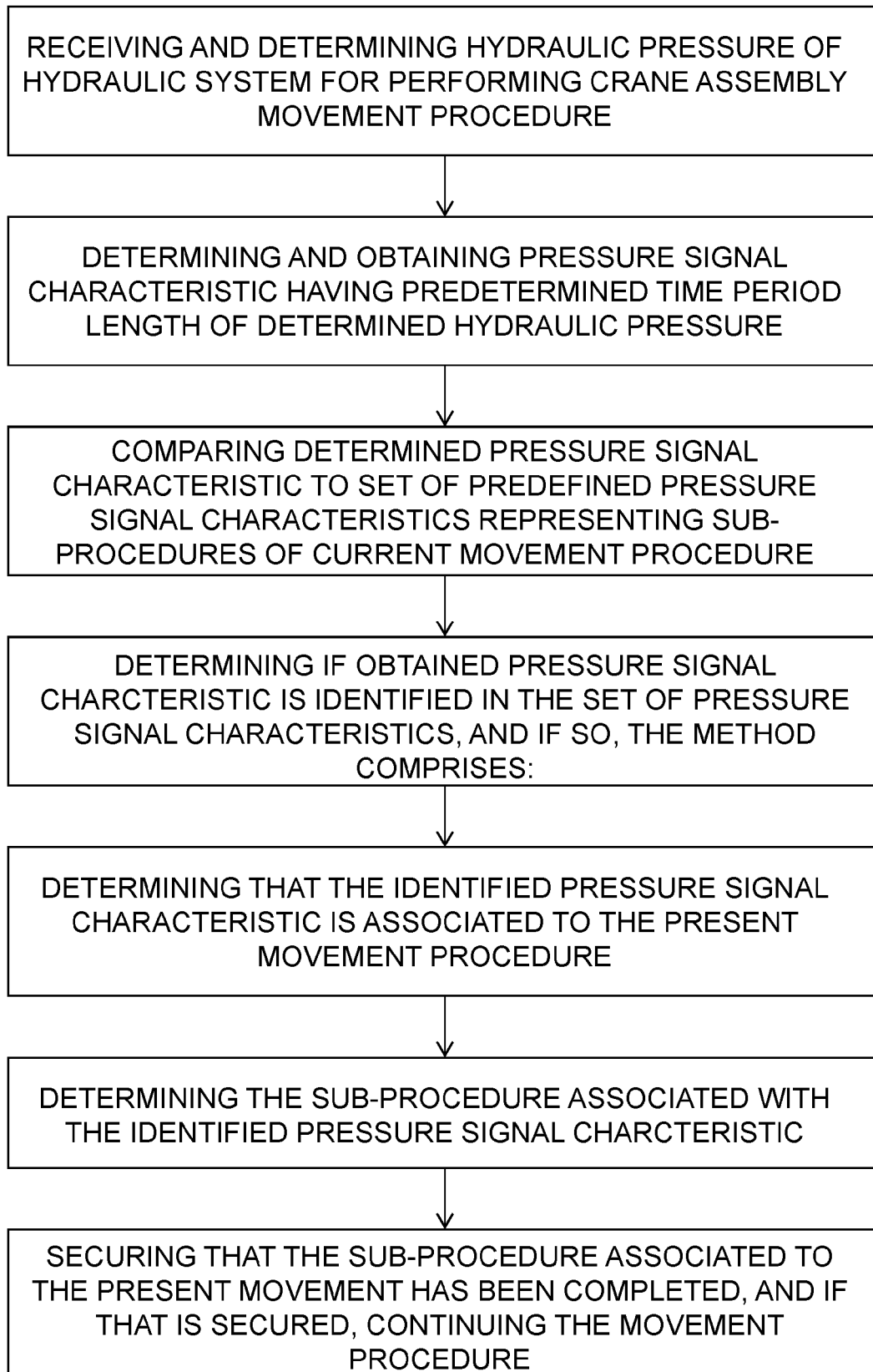


FIG. 4



EUROPEAN SEARCH REPORT

Application Number

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			B66C
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 March 2023	Examiner Serafeim, Athanasios
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