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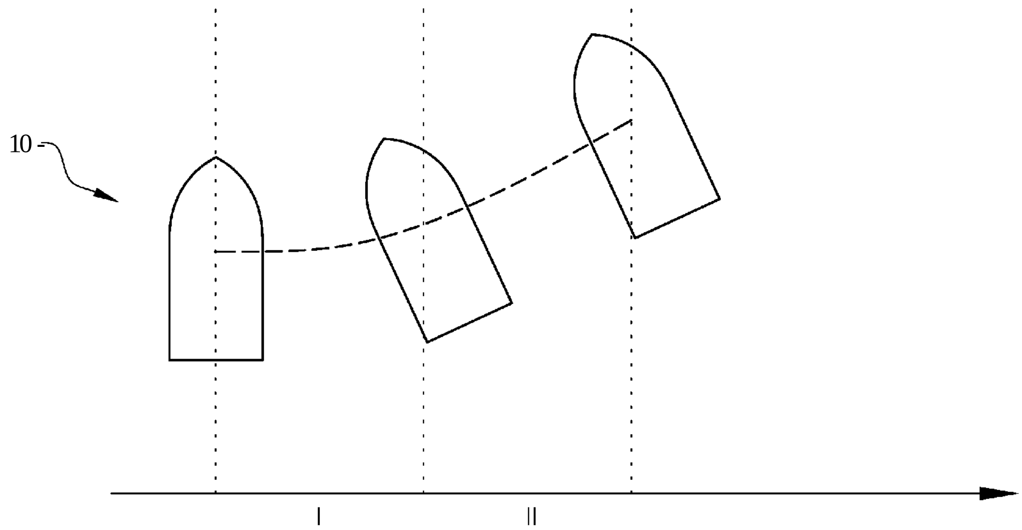

FIG. 4

(57) Abstract: The invention relates to a control arrangement (16) for steering a marine vessel (10). The marine vessel (10) comprises a propulsion unit set (12) which in turn comprises at least one propulsion unit (14, 14', 14"). The control arrangement (16) comprises a calibration mode in which the control arrangement (16) is adapted to: - determine a motion request indicative of a desired motion of the marine vessel (10); - issue a control signal set to the propulsion unit set (12) for obtaining the desired motion. Moreover, in the calibration mode, the control arrangement (16) is adapted to: - receive an actual motion signal indicative the actual motion of the marine vessel (10); - on the basis of a motion difference between the actual motion of the marine vessel (10) and the desired motion of the marine vessel (10), determine a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and - store the control signal offset and the desired motion.

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A control arrangement

TECHNICAL FIELD

The invention relates to a control arrangement for steering a marine vessel. Moreover, the present invention relates to a propulsion assembly for propelling a marine vessel and the present invention also relates to a marine vessel. Furthermore, the present invention relates to a method for calibrating a control arrangement of a marine vessel.

The invention can be applied in marine vessels. Although the invention will be described with respect to a marine vessel comprising an outboard propulsion unit set, the invention is not restricted to this particular marine vessel type, but may also be used in other marine vessels, such as marine vessels with an inboard propulsion system.

BACKGROUND

Present-day marine vessels may be equipped with one or more propulsion units and a control arrangement for steering by issuing control signals to the one or more propulsion units. Furthermore, marine vessels may be equipped with a manually operable actuator, such as a joystick, by which an operator may control the direction as well as the speed of the marine vessel via a single actuator.

Moreover, contemporary control arrangements may be adapted to control the marine vessel such that is subjected to motions other than a pure forward/backward motion or a turn. Purely by way of example, a marine vessel of today may have a docking mode in which the marine vessel moves in a more or less pure sway direction, i.e. a transverse direction, of the marine vessel.

In view of the above, it is generally desired that a motion request made by an operator actually results in a corresponding motion of the marine vessel.

SUMMARY

An object of the invention is to provide a control arrangement for steering a marine vessel which ensures that an operator's motion request results in a motion of the marine vessel which appropriately corresponds to the motion request.

According to a first aspect of the invention, the object is achieved by a control arrangement according to claim 1.

As such, a first aspect of the present invention relates to a control arrangement for steering a marine vessel, the marine vessel comprising a propulsion unit set which in turn comprises at least one propulsion unit. The control arrangement comprises a calibration mode in which the control arrangement is adapted to:

- determine a motion request indicative of a desired motion of the marine vessel;
- issue a control signal set to the propulsion unit set for obtaining the desired motion.

Moreover, in the calibration mode, the control arrangement further is adapted to:

- receive an actual motion signal indicative the actual motion of the marine vessel;
- on the basis of a motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel, determine a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and
- store the control signal offset and the desired motion.

A discrepancy between the desired and actual motions of the marine vessel may be occasioned by one or more of several conditions. For instance, the current floating condition, such as the displacement and/or the centre of buoyancy, of the marine vessel may have an influence on the actual motion of the vessel. Further, the actual position of each propulsion unit in the propulsion unit set, relative to the hull of the marine vessel, may also have an effect on the actual motion of the marine vessel. Thus, by virtue of the above recited control arrangement, it is possible to reduce any differences between the desired motion and the actual motion, thus calibrating the control arrangement, in an automatic manner.

The automatic calibration in turn implies an increased possibility to obtain an accurate calibration, since the calibration may not be dependent on actions or subjective evaluations made by an operator of the marine vessel. Furthermore, the above control arrangement may increase the safety of a calibration procedure since an operator of the marine vessel during a calibration procedure may focus on monitoring the surroundings of the marine vessel rather than putting emphasis on the calibration as such.

As used herein, the expression "motion" may comprise one of the following: acceleration, velocity and displacement. Moreover, the expression "motion" may comprise any combination of acceleration, velocity and displacement.

Preferably, the propulsion unit set comprises at least two propulsion units. By virtue of two propulsion units, it is possible to increase the versatility of the motions that the marine vessel can be subjected to. By way of example, each one of a thrust level and a steering angle of each propulsion unit in the propulsion unit set may be individually controllable.

Optionally, the motion request is indicative of a desired motion of the marine vessel which comprises an acceleration of the marine vessel. The acceleration of the marine vessel may provide accurate and swift information about any difference between the desired and actual motions and may be used for determining the control signal offset in a time-efficient manner. Moreover, an acceleration of a marine vessel is generally relative straightforward to determine, for instance using a global positioning system and/or one or more acceleration sensors.

Optionally, the motion request is indicative of a desired motion of the marine vessel which is a pure sway motion. A pure sway motion may be used during for instance a docking procedure during which it is generally desired that the marine vessel moves as intended. Thus, calibrating the control arrangement for a pure sway motion may enhance the operability of the marine vessel.

Optionally, the motion request is indicative of a desired motion of the marine vessel which comprises a yaw acceleration and/or a surge acceleration.

Optionally, the motion request is indicative of a desired motion of the marine vessel which is a pure yaw motion. Calibrating the control arrangement using a pure yaw motion may be desired since a pure yaw motion may involve operating at least one propulsion unit in reverse gear and a propulsion unit generally has different thrust characteristics in forward and reverse gear. Moreover, the hull of the marine vessel may have different drag characteristics in forward and backward motions, respectively. As such, the use of a pure yaw motion may give valuable information indicative of the marine vessel configuration and/or constitution.

Optionally, the motion request is indicative of a desired motion of the marine vessel which comprises a surge acceleration and/or a sway acceleration.

Optionally, the control arrangement is adapted to determine the control signal offset using a feedback loop. The feedback loop is an appropriate implementation for arriving at a control signal offset.

Optionally, the marine vessel comprises a manually operable actuator, such as a joystick, for issuing the motion signal to the control arrangement.

Optionally, the control arrangement is adapted to automatically deactivate the calibration mode when the motion difference is within the predetermined motion difference range.

Optionally, the control arrangement is adapted to determine a parameter indicative of the floating condition of the marine vessel, preferably the parameter comprises the horizontal centre of buoyancy of the marine vessel, on the basis of the motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel. The floating condition of the marine vessel, such as the horizontal centre of buoyancy, may have an influence on the actual motion of the marine vessel. For instance, the position of the horizontal centre of buoyancy of the marine vessel may have an influence on yaw motions of the marine vessel. As such, the determination of a parameter indicative of the floating condition of the marine vessel may provide useful information when determining the control signal offset.

Optionally, the control arrangement is adapted to determine an offset thrust vector required to reduce the motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel to thereby determine the control signal offset.

A second aspect of the present invention relates to a propulsion assembly for propelling a marine vessel. The propulsion assembly comprises a propulsion unit set which in turn comprises at least one propulsion unit. The propulsion assembly also comprises a control arrangement according to the first aspect of the present invention.

Optionally, the propulsion assembly further comprises means for determining the actual motion of the marine vessel, preferably the means comprises a global positioning system.

A third aspect of the present invention relates to a marine vessel comprising the propulsion assembly according to the second aspect of the present invention and/or a control arrangement according to the first aspect of the present invention.

A fourth aspect of the present invention relates to a method for calibrating a control arrangement of a marine vessel. The marine vessel comprises a propulsion unit set which in turn comprises at least one propulsion unit. The method comprises:

- receiving a motion signal indicative of a desired motion of the marine vessel;
- issuing a control signal set to the propulsion unit set for obtaining the desired motion.

The method further comprises:

- receiving an actual motion signal indicative of the actual motion of the marine vessel;
- on the basis of a motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel, automatically determining a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and
- storing the control signal offset and the desired motion.

Further advantages and advantageous features of the invention are disclosed in the following description and in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

In the drawings:

Fig. 1 is schematic drawing of an embodiment of a marine vessel;

Fig. 2 is schematic drawing of another embodiment of a marine vessel;

Fig. 3 is a flow chart illustrating an implementation of a feedback loop;

Fig. 4 schematically illustrates an implementation of a calibration procedure, and

Fig. 5 schematically illustrates another implementation of a calibration procedure.

DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS OF THE INVENTION

Fig. 1 illustrates an embodiment of a marine vessel 10. The Fig. 1 marine vessel 10 is exemplified as a boat, such as a leisure boat. As a non-limiting example, embodiments of the marine vessel may have a length (length between perpendiculars) within the range of 3 to 20 meters.

As may be gleaned from Fig. 1, the embodiment of the marine vessel 10 illustrated therein comprises a propulsion unit set 12 which in turn comprises at least one propulsion unit 14. In the embodiment illustrated in Fig. 1, the propulsion unit set 12 comprises a single propulsion unit 14 which is implemented as an outboard engine. Embodiments of the marine vessel 10 may comprise a propulsion assembly set comprising two or more propulsion units. To this end, reference is made to Fig. 2, illustrating a propulsion unit set 12 with two propulsion units 14', 14''. The propulsion unit set 12 is operable to impart a thrust vector on the marine vessel 10 to thereby obtain a motion of the marine vessel.

Each one of Fig. 1 and Fig. 2 further illustrates that the marine vessel 10 comprises a hull 15 hosting the propulsion unit set 12.

It is also envisaged that embodiments of the marine vessel 10 may comprise a propulsion unit set 12 with one or more propulsion unit that is not an outboard engine. Purely by way of example, it is envisaged that implementations of the propulsion unit set 12 may comprise an inboard propulsion system (not shown) with one or more drive units (not shown). As another example, it is envisaged that implementations of the propulsion unit set 12 may comprise one or more thrusters (not shown), e.g. so-called pods (not shown).

Furthermore, each one of the Fig. 1 and Fig. 2 embodiments illustrates implementations of the propulsion unit set 12 wherein each one of a thrust level and a thrust direction of each propulsion unit 14, 14', 14" in the propulsion unit set 12 is individually controllable. However, it is also envisaged that other embodiments of the marine vessel 10 may comprise a propulsion unit set 12 which in turn comprise at least one propulsion unit the thrust level or thrust direction of which is not individually controllable. Purely by way of example, it is envisaged that implementations of the propulsion unit set 12 may comprise at least one propulsion unit (not shown) having a fixed thrust direction. An example of such a propulsion unit may be a fixed bow thruster. For instance, a propulsion unit set 12 may comprise at least one propulsion unit with a fixed thrust direction and at least one propulsion unit with an individually controllable thrust level and thrust direction.

Furthermore, it is also envisaged that implementations of the propulsion unit set 12 may comprise one or more rudders (not shown) that can be used together with propulsion units with fixed thrust directions, or in addition to one or more thrusters with a controllable thrust direction, for controlling the heading of the marine vessel 10.

Moreover, the marine vessel 10 comprises a control arrangement 16 for steering the marine vessel 10. The control arrangement 16 and the propulsion unit set 12 form a propulsion assembly 18 for propelling the marine vessel 10.

The control arrangement 16 may be adapted to receive instructions from an operator via a manually operable actuator 20. Purely by way of example, the manually operable actuator may comprise at least one of a lever, a knob, a button or a touch screen (not shown). Furthermore, the control arrangement 16 may be adapted to, for instance on the basis of instructions received by from the manually operable actuator 20, issue signals for controlling the thrust level and the thrust direction of each propulsion unit in the set 12. Purely by way of example, such signals may be transmitted directly to each propulsion unit or the signals may be transmitted to a propulsion unit controller (not shown) for further transport to each propulsion unit.

Moreover, the marine vessel 10 may comprise a positioning system 22, such as a global positioning system, which may be adapted to communicate with the control unit 16.

Purely by way of example, each one of the manually operable actuator 20 and the positioning system 22 may form part of the propulsion assembly 18.

Fig. 1 also illustrates a coordinate system for the marine vessel 10 and as well as presenting a nomenclature for rotations of the marine vessel 10. To this end, the coordinate system has a longitudinally extending X-axis, a transversally extending Y-axis and a vertically extending Z-axis. The X-, Y- and Z-axes are perpendicular to each other.

Moreover, Fig. 1 illustrates that rotation around the X-axis is referred to as roll, rotation around the Y-axis is referred to as pitch and rotation around the Z-axis is referred to as yaw. Additionally, Fig. 1 exemplifies the position of the horizontal centre of buoyancy 24 of the marine vessel 10. The centre of buoyancy is the centre of gravity of the volume displaced by the marine vessel 10 and the horizontal centre of buoyancy is consequently the horizontal location (in the X-Y-plane) of the centre of buoyancy.

The control arrangement 16 comprises a calibration mode in which the control arrangement 16 is adapted to: determine a motion request indicative of a desired motion of the marine vessel 10 and issue a control signal set to the propulsion unit set 12 for obtaining the desired motion.

Purely by way of example, the above-mentioned motion request may be determined by receiving a motion signal which, by way of example, may be issued by the manually operable actuator 20. As such, though only mentioned as an example, the calibration mode may be initiated by the operator issuing a calibration mode signal, for instance using the manually operable actuator 20 or another actuator (not shown) specifically dedicated for issuing a calibration mode signal, and the operator may then actuate the manually operable actuator 20 so as to transmit the motion signal to the control arrangement 16. As such, the operator may select for which type of motion the control arrangement 16 should be calibrated.

However, it is also envisaged that the control arrangement 16 may receive an automatically generated motion signal that should be used during the calibration mode. Purely by way of example, the motion signal may be automatically generated by the manually operable actuator 20 or by another actuator (not shown) when the operator actuates the relevant actuator in order to set the control arrangement in the calibration mode. Moreover, the control arrangement 16 itself may be adapted to determine the motion request upon the receipt of a request to enter the calibration mode.

Purely by way of example, the motion request may be indicative of a predetermined desired motion of the marine vessel 10 during the calibration mode. For instance, such a predetermined desired motion may comprise a sequence of different desired motion types. As another non-limiting example, embodiments of the control arrangement 16 may allow an operator of the marine vessel 10 to select between a set of predetermined desired motions for which the control arrangement 16 should be calibrated.

Irrespective of how the motion signal is generated, in the calibration mode, the control arrangement further is adapted to receive an actual motion signal indicative the actual motion of the marine vessel. Purely by way of example, the actual motion signal may be determined using one or more sensors. For instance, the actual motion signal may be determined using the previously mentioned positioning system 22. However, instead of, or in addition to the positioning system 22, the actual motion signal may for instance be determined using another type of sensor, such as one or more acceleration sensors or one or more so called "speed over water" sensors.

Moreover, on the basis of a motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel, the control arrangement 16 is adapted to determine a control signal offset required in order for the motion difference to be within a predetermined motion difference range. Further, the control arrangement 16 is adapted to store the control signal offset and the desired motion. For instance, the control signal offset and the desired motion may be stored in a memory (not shown) forming part of the control arrangement 16.

The thus-stored data may subsequently be used when the marine vessel 10 is operated so as to undergo a motion similar to the stored desired motion. As such, if a pure sway motion has been stored as a desired motion and the marine vessel 10 is subsequently requested to move in a pure sway motion, the stored control signal offset, associated with the stored pure sway desired motion, may be read and used when generating control signals to the propulsion unit set 12. Purely by way of example, the stored control signal offset, associated with the stored pure sway desired motion, may be combined with a nominal control signal for obtaining the desired motion.

Moreover, the stored control signal offset and said desired motion may also be used as a starting point for a subsequent calibration. As such, if an operator operates the control arrangement so as to perform a calibration for a desired motion and a control signal offset has previously been stored for the same, or at least a similar, desired motion, the control arrangement may read the control signal offset thus stored and use that information as an initial control signal offset when operating the control arrangement 16 in the calibration mode. The control arrangement 16 may then determine an updated control signal offset in a time-efficient manner.

As has been intimated hereinabove, the expression "motion" may encompass one or more of an acceleration, a speed and a displacement in any direction, preferably a horizontal direction, be it a translation or a rotation. As a non-limiting example, the motion request may be indicative of a desired motion of the marine vessel which may comprise an acceleration of the marine vessel. An acceleration may be relatively straightforward to determine, e.g. using one or more of the previously mentioned positioning system 22 or the one or more acceleration sensors.

Optionally, the control arrangement is adapted to determine the control signal offset using a feedback loop, also referred to as closed loop. An example of a feedback loop is illustrated in Fig. 3. As may be gleaned from Fig. 3, the feedback loop determines the difference between the desired motion D and the actual motion A. In the Fig. 3 example, the actual motion A is determined using a positioning system 22, although other systems/sensors may be used in other implementations of the feedback loop.

The above difference E, which is often referred to as an error signal, is thereafter fed to the control arrangement 16. Based on the difference, the control arrangement 16 determines a control signal offset and sends a control signal - which has been determined taking the control signal offset into account - to the propulsion unit set 12 such that the propulsion unit set 12 is operated so as to impart a motion on the marine vessel (not shown in Fig. 3). In an example wherein the control signal offset is indicative of an offset thrust vector required to reduce the difference E between the actual motion A and the desired motion D, the control signal may comprise a nominal control signal, indicative of a nominal thrust vector produced by the propulsion unit set 12, and the control signal offset, which may be indicative of a thrust level offset and/or steering angle offset for one or more propulsion unit - or one or more rudders, if the propulsion unit set comprises one or more rudders - of the propulsion unit set 12.

Fig. 4 illustrates an implementation of a calibration procedure wherein the motion request is indicative of a desired motion of the marine vessel 10 which is a pure sway motion. More specifically, in the Fig. 4 implementation, the desired motion is pure sway acceleration. As such, in the Fig. 4 implementation, each one of the surge acceleration and the yaw acceleration should be zero.

Moreover, Fig. 4 illustrates the marine vessel 10 during a calibration procedure wherein the control arrangement 16 issues control signals to the propulsion unit set 12 in order to arrive at a pure sway acceleration of the marine vessel 10. As may be gleaned from Fig. 4, the calibration procedure comprises a first phase I wherein the surge acceleration and the yaw acceleration are non-zero, as a result of which the motion of the marine vessel 10 deviates from the desired motion. However, Fig. 4 also illustrates that the calibration procedure comprises a second phase II - when the control arrangement 16 has determined an appropriate control signal offset - wherein the surge acceleration and the yaw acceleration are substantially zero, as a result of which the motion of the marine vessel 10 substantially corresponds to the desired motion, viz the pure sway acceleration.

Fig. 5 illustrates another implementation of a calibration procedure wherein the motion request is indicative of a desired motion of the marine vessel 10 which is a pure yaw motion. As such, during the Fig. 5 calibration procedure, a control signal offset is determined in order to make the marine vessel 10 undergo a yaw rotation only, i.e. the marine vessel should not undergo any translational displacement, such as a surge motion or a sway motion.

In addition to the examples presented hereinabove with reference to Fig. 4 and Fig. 5, in other embodiments of the control arrangement 16, the motion request may be indicative of a desired motion of the marine vessel 10 which may comprise a surge acceleration and/or a surge velocity.

In the above example with the surge velocity, the thrust produced by the propulsion unit set 12 is selected such that the motion difference is within a predetermined motion difference range. On the basis of the thrust needed in order to obtain a desired motion difference, the control signal offset may be determined.

Irrespective of which motion is used as the desired motion, and irrespective of the control strategy employed for determining an adequate control signal offset, the control arrangement may be adapted to automatically deactivate the calibration mode when the motion difference, i.e. the difference between the actual motion A and the desired motion D, is within the predetermined motion difference range. Purely by way of example, the predetermined motion difference range may be ±20%, preferably ±10%, of a value indicative of the magnitude of the desired motion D.

As has been intimated herein above, the control signal offset may be indicative of an offset thrust vector - provided by the propulsion unit set 12 - required for the motion difference E to be within a predetermined motion difference range.

Moreover, in embodiments of the control arrangement 16, the control signal offset may be determined using information indicative of the floating condition of the marine vessel 10.

As such, in embodiments of the control arrangement 16, the control arrangement 16 may be adapted to determine a parameter indicative of the floating condition of the marine vessel 10 - preferably, the parameter comprises the horizontal centre of buoyancy 24 (see Fig. 1) of the marine vessel 10 - on the basis of the detected motion difference between the actual motion of the marine vessel and the desired motion of the marine vessel. Thus, the parameter may comprise information indicative of the horizontal centre of buoyancy 24 in each one of the X- and Y-directions. The horizontal centre of buoyancy 24 may for instance be used when determining a yaw moment imparted by the propulsion unit set 12 and may consequently also be used when determining an appropriate control signal offset.

Instead of, or in addition to, the floating condition of the marine vessel 10, the control signal offset may be determined using information indicative of the centre of gravity of the marine vessel 10. The centre of gravity, in particular the horizontal centre of gravity, may also provide useful information when determining e.g. a yaw moment imparted by the propulsion unit set 12.

The present invention also relates to a method for calibrating a control arrangement 16 of a marine vessel 10. The marine vessel 10 comprises a propulsion unit set 12 which in turn comprises at least one propulsion unit 14. The method comprises:

- receiving a motion signal indicative of a desired motion of the marine vessel 10;
- issuing a control signal set to the propulsion unit set 12 for obtaining the desired motion.
- receiving an actual motion signal indicative the actual motion of the marine vessel 10;
- on the basis of a motion difference between the actual motion of the marine vessel 10 and the desired motion of the marine vessel 10, automatically determining a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and storing the control signal offset and the desired motion.

It is to be understood that the present invention is not limited to the embodiments described above and illustrated in the drawings; rather, the skilled person will recognize that many changes and modifications may be made within the scope of the appended claims.

CLAIMS

1. A control arrangement (16) for steering a marine vessel (10), said marine vessel (10) comprising a propulsion unit set (12) which in turn comprises at least one propulsion unit (14, 14', 14"), said propulsion unit set (12) being operable to impart a thrust on said marine vessel (10) to thereby obtain a motion of said marine vessel (10), said control arrangement (16) comprising a calibration mode in which the control arrangement (16) is adapted to:

- determine a motion request indicative of a desired motion of the marine vessel (10);
- issue a control signal set to said propulsion unit set (12) for obtaining said desired motion;

characterized in that, in said calibration mode, said control arrangement (16) further is adapted to:

- receive an actual motion signal indicative the actual motion of the marine vessel (10);
- on the basis of a motion difference between said actual motion of the marine vessel (10) and said desired motion of the marine vessel (10), determine a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and
- store said control signal offset and said desired motion.

2. The control arrangement (16) according to claim 1, wherein said motion request is indicative of a desired motion of said marine vessel (10) which comprises an acceleration of said marine vessel (10).

3. The control arrangement (16) according to claim 1 or claim 2, wherein said motion request is indicative of a desired motion of the marine vessel (10) which is a pure sway motion.

4. The control arrangement (16) according to claim 3, when dependent on claim 2, wherein said motion request is indicative of a desired motion of said marine vessel (10) which comprises a yaw acceleration and/or a surge acceleration.

5. The control arrangement (16) according to claim 1 or claim 2, wherein said motion request is indicative of a desired motion of the marine vessel (10) which is a pure yaw motion.

6. The control arrangement (16) according to claim 5, when dependent on claim 2, wherein said motion request is indicative of a desired motion of said marine vessel (10) which comprises a surge acceleration and/or a sway acceleration.

7. The control arrangement (16) according to any one of the preceding claims, wherein said control arrangement (16) is adapted to determine said control signal offset using a feedback loop.

8. The control arrangement (16) according to any one of the preceding claims, wherein said marine vessel (10) comprises a manually operable actuator (20), such as a joystick, for issuing said motion signal to said control arrangement (16).

9. The control arrangement (16) according to any one of the preceding claims, wherein said control arrangement (16) is adapted to automatically deactivate said calibration mode when said motion difference is within said predetermined motion difference range.

10. The control arrangement (16) according to any one of the preceding claims, wherein said control arrangement (16) is adapted to determine a parameter indicative of the floating condition of said marine vessel (10), preferably said parameter comprises the horizontal centre of buoyancy (24) of the marine vessel (10), on the basis of said motion difference between said actual motion of the marine vessel (10) and said desired motion of the marine vessel (10).

11. The control arrangement (16) according to any one of the preceding claims, wherein said control arrangement (16) is adapted to determine an offset thrust vector required to reduce said motion difference between said actual motion of the marine vessel (10) and said desired motion of the marine vessel (10) to thereby determine said control signal offset.

12. A propulsion assembly for propelling a marine vessel (10), said propulsion assembly comprising a propulsion unit set (12) which in turn comprises at least one propulsion unit

(14, 14', 14"), and a control arrangement (16) according to any one of the preceding claims.

13. The propulsion assembly according to claim 12, further comprising means for determining the actual motion of the marine vessel (10), preferably said means comprising a global positioning system (22).

14. A marine vessel (10) comprising the propulsion assembly according to any one of claim 12 or 13 and/or a control arrangement (16) according to any one of claims 1 - 11.

15. A method for calibrating a control arrangement (16) of a marine vessel (10), said marine vessel (10) comprising a propulsion unit set (12) which in turn comprises at least one propulsion unit (14, 14', 14"), said method comprising:

- receiving a motion signal indicative of a desired motion of the marine vessel (10);
- issuing a control signal set to said propulsion unit set (12) for obtaining said desired motion;

characterized by:

- receiving an actual motion signal indicative the actual motion of the marine vessel (10);
- on the basis of a motion difference between said actual motion of the marine vessel (10) and said desired motion of the marine vessel (10), automatically determining a control signal offset required in order for the motion difference to be within a predetermined motion difference range, and
- storing said control signal offset and said desired motion.

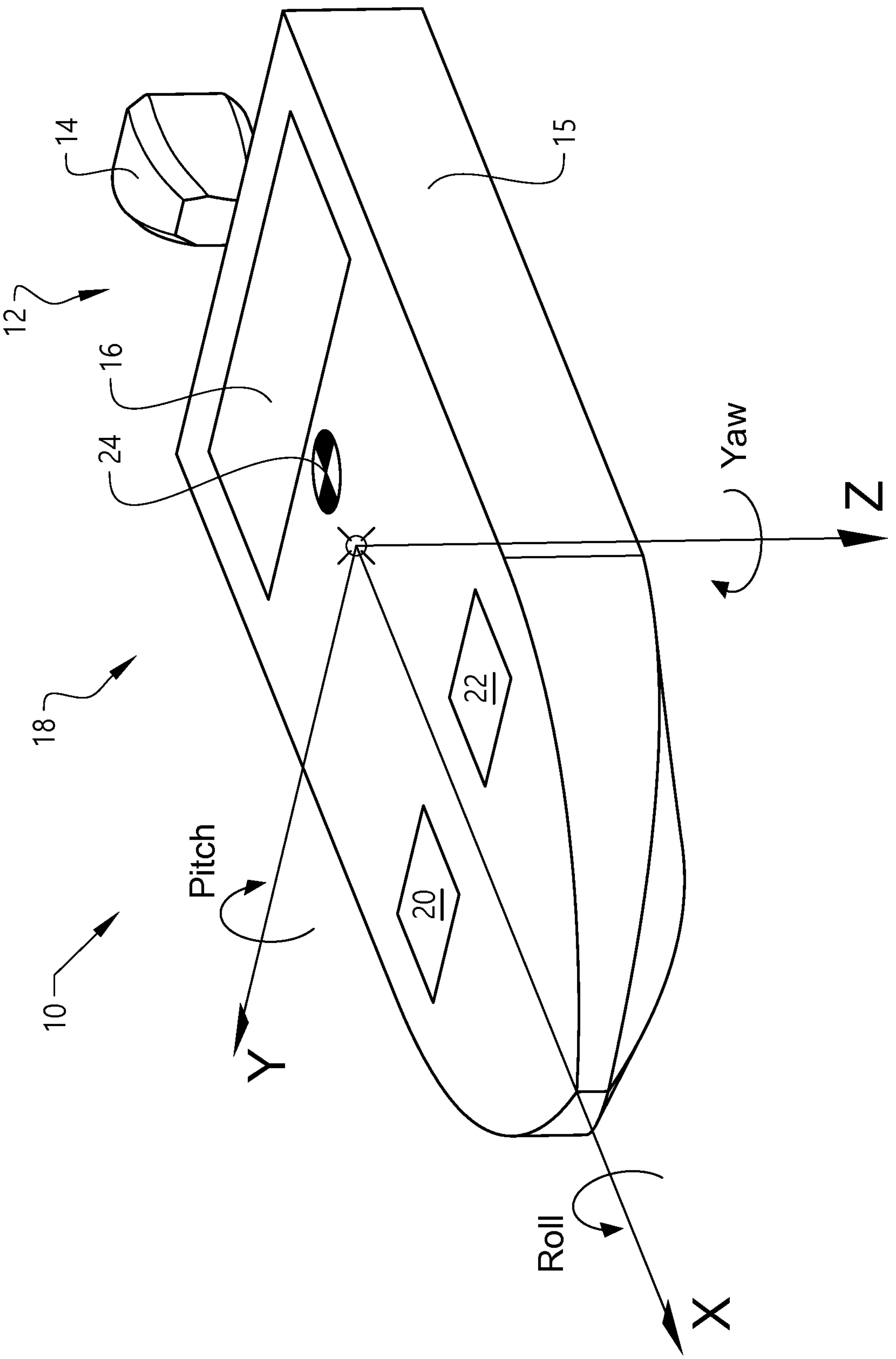

FIG. 1

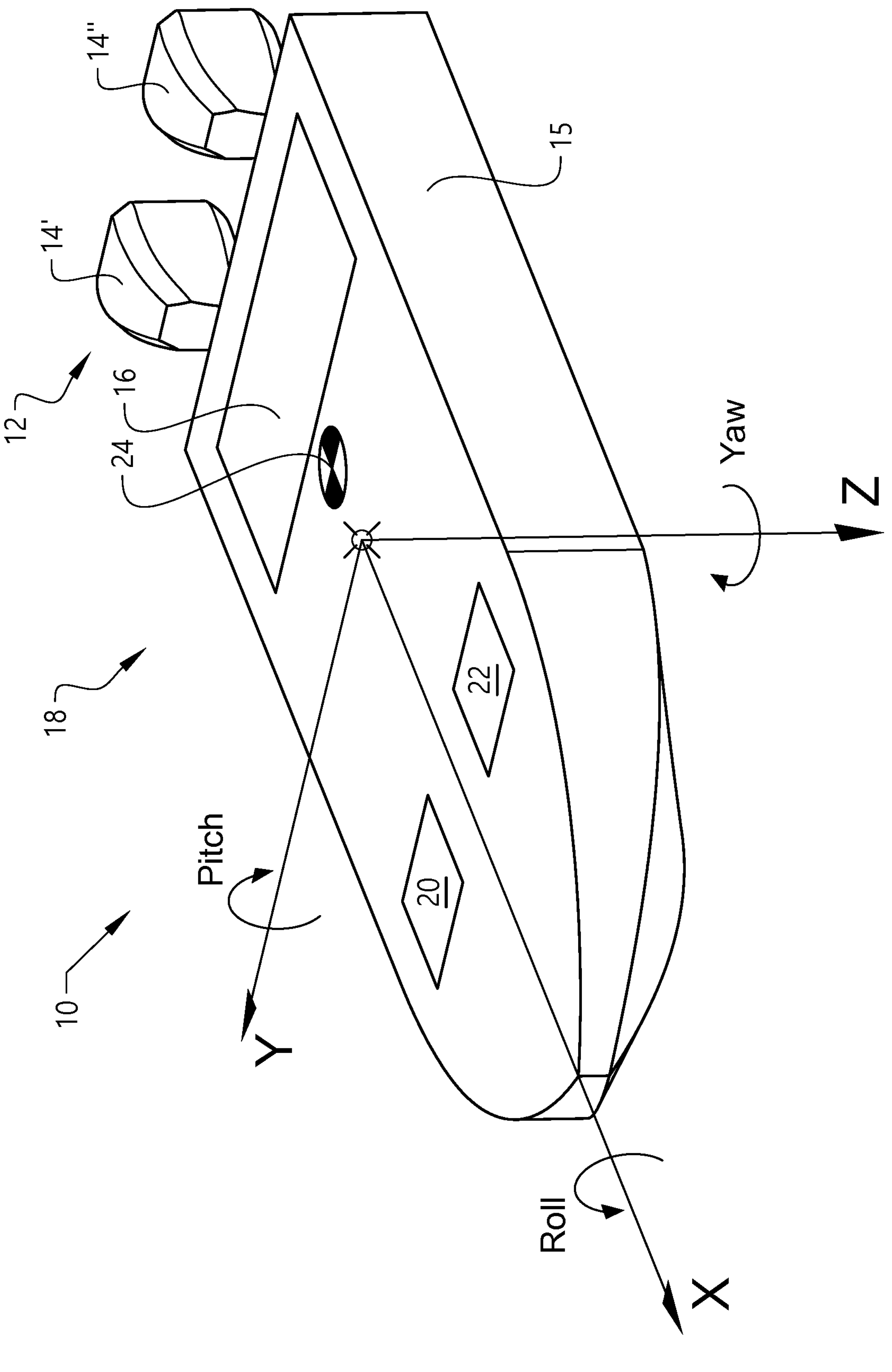

FIG. 2

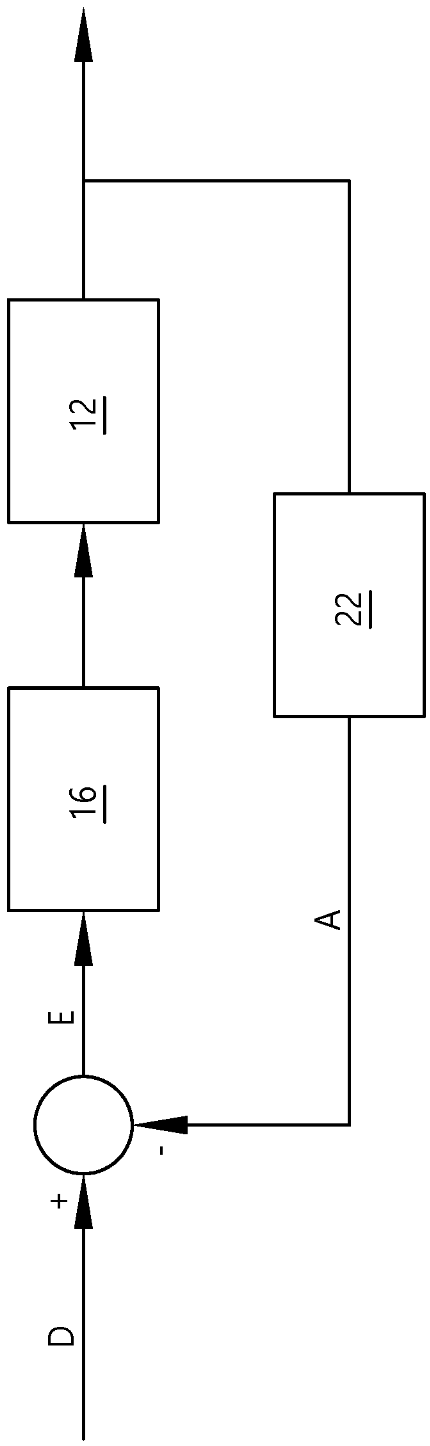

FIG. 3

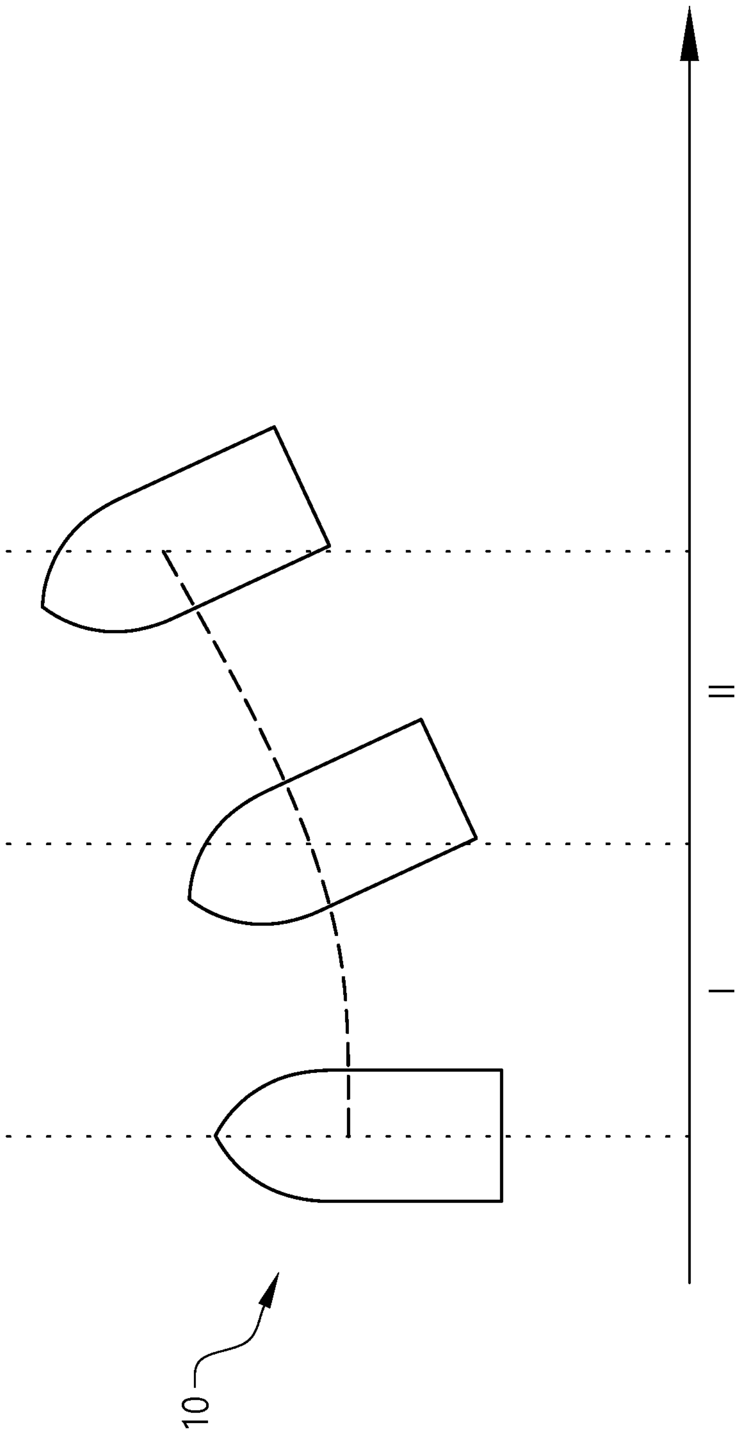

FIG. 4

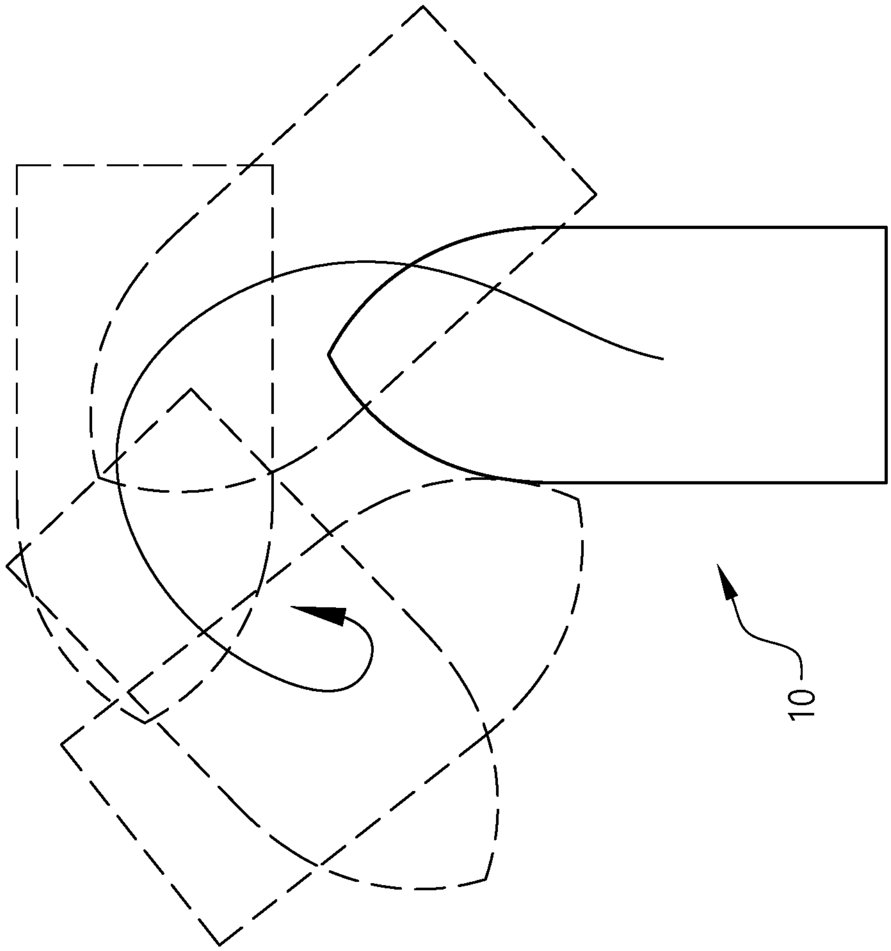

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No
PCT/EP2017/067935

A. CLASSIFICATION OF SUBJECT MATTER
INV. B63H25/42 B63H21/21 B63H20/00 G05D1/02
ADD.

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B63H G05D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

EPO-Internal , WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	EP 2 907 740 A1 (SUZUKI MOTOR CORP [JP]) 19 August 2015 (2015-08-19) paragraph [0013] paragraph [0055] - paragraph [0057] figures -----	1-15
X	WO 2006/040785 A1 (SODDU ANDREA [IT]; MONGIARDO LORENZO [IT]; BERTAZZONI STEFANO [IT]) 20 April 2006 (2006-04-20) page 10, line 20 page 27, line 17 - line 35 claims 55,57 -----	1-15
X	US 2015/378361 A1 (WALKER COLLIN [US] ET AL) 31 December 2015 (2015-12-31) paragraph [0103]; figures -----	1,15
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[X] Further documents are listed in the continuation of Box C.

[X] See patent family annex.

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
29 March 2018	11/04/2018

Name and mailing address of the ISA/	Authorized officer
European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Barre, Vincent

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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No
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			WO	2015114781	Al	06-08-2015
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