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(54) **A PROPELLER DRIVE ARRANGEMENT**

PROPELLERANTRIEBSANORDNUNG

AGENCEMENT D'ENTRAÎNEMENT D'HÉLICE

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(56) References cited:
**GB-A- 531 756** **GB-A- 569 056**

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## Description

### TECHNICAL FIELD

**[0001]** The invention relates to a propeller drive arrangement. The invention also relates to a vessel comprising a propeller drive arrangement.

**[0002]** The invention can be applied in marine vessels, such as in sailing vessels.

### BACKGROUND

**[0003]** A marine vessel may comprise a propeller drive arrangement with a propeller hub comprising one or more propeller blades. The pitch angle of the propeller blades may be adjustable.

**[0004]** For example, it is known to equip a sailing vessel with a propeller drive arrangement comprising the above-mentioned propeller hub. The propeller drive arrangement may be driven by a motor, such as by an electric motor, which is powered by use of an electric energy storage system. For example, the energy storage system may be a battery, such as a lithium-ion battery.

**[0005]** During sailing of the sailing vessel, power may be regenerated to the energy storage system, i.e. the electric motor may also function as an electric generator. For this purpose, the pitch angle(s) of the one or more propeller blades may be adjusted to optimize the regeneration of power, e.g. for improved energy efficiency.

**[0006]** Additionally, or alternatively, it may also be advantageous to adjust the pitch angle when a propulsion force is generated by the propeller drive arrangement.

**[0007]** In view of the above, there is a strive to develop a reliable, robust, compact, efficient and/or cost-effective propeller drive arrangement with adjustable propeller blade pitch angle(s).

**[0008]** GB 531 756 A relates to a propeller drive arrangement using two planetary gears for adjusting propeller blade pitch angles.

### SUMMARY

**[0009]** An object of the invention is to provide an improved propeller drive arrangement which alleviates at least one drawback of the prior art, or which at least provides a suitable alternative. Another object of the invention is to provide an improved vessel, such as a sailing vessel, which alleviates at least one drawback of the prior art, or which at least provides a suitable alternative.

**[0010]** According to a first aspect of the invention, the object is achieved by a propeller drive arrangement according to claim 1.

**[0011]** Thus, there is provided a propeller drive arrangement, comprising:

- a propeller shaft,
- a propeller hub comprising one or more propeller blades, wherein a pitch angle of the one or more propeller blades is variable,
- a planetary gear comprising a first planetary gear member, a second planetary gear member and a third planetary gear member which are drivingly connected,
- an outer shaft arranged coaxially with and radially outside of the propeller shaft,
- a gear wheel set drivingly connecting the second planetary gear member with the outer shaft,

wherein the outer shaft is drivingly connected to the one or more propeller blades for varying the pitch angle,
wherein the propeller shaft, in one end thereof, is configured to be drivingly connected to a propulsion unit and, in a second end thereof, is drivingly fixed to the propeller hub,
wherein the propeller shaft is drivingly fixed to the first planetary gear member, and
wherein the second planetary gear member is arranged to drive the outer shaft via the gear wheel set by a driving torque exerted on the propeller shaft, and

- the propeller drive arrangement further comprising a pitch controlling actuator for controlling the pitch angle of the one or more propeller blades,

wherein the pitch controlling actuator is arranged to, in a first state, engage the third planetary gear member to a housing so that the propeller shaft and the outer shaft are arranged to rotate with the same rotational speed, and, in a second state, actuate the third planetary gear member so that the third planetary gear member rotates with respect to the housing.

**[0012]** By the provision of the propeller drive arrangement as disclosed herein, an improved propeller drive arrangement is achieved. For example, the present invention is based on a realization that the pitch angle can be efficiently controlled by use of a pitch controlling actuator and by only one planetary gear which is drivingly connected to the one or more propeller blades for varying the pitch angle. Thereby, a compact configuration is achieved, implying e.g. a reduced need of adding further gears for achieving the function of the propeller drive arrangement. This also implies a more reliable and robust configuration since few components are required for the pitch angle function of the propeller drive arrangement.

**[0013]** By controlling the pitch angle by the pitch controlling actuator as disclosed herein is meant to vary, or adjust, the pitch angle of the one or more propeller blades, and also to maintain the one or more propeller blades at a fixed pitch angle. The pitch angle of each propeller blade is adjusted with respect to a respective pitch angle rotational axis of the respective propeller blade. The pitch angle rotational axis of each propeller blade preferably extends along a radial direction of the propeller shaft.

**[0014]** When the propeller shaft and the outer shaft rotate with the same rotational speed, the pitch angle of the one or more propeller blades is fixed. In addition, when the third planetary gear member rotates with respect to the housing, the pitch angle of the one or more propeller blades is adjusted.

**[0015]** Each one of the first, second and third planetary gear members of the planetary gear is a respective one of a sun gear, a planet carrier carrying a plurality of planetary gear wheels, and a ring gear. Accordingly, by way of example, several different combinations are feasible for achieving the variable pitch angle function as disclosed herein. For example, if the pitch controlling actuator is used for engaging the ring gear to the housing, the propeller shaft may either be drivingly fixed to the sun gear or to the planet carrier. In other words, it has been realized that six different configurations are feasible, or three times two different configurations.

**[0016]** Optionally, the first planetary gear member is a sun gear of the planetary gear. This implies a simplified configuration where the sun gear, which is closest to a rotational axis of the planetary gear, is drivingly fixed to the propeller shaft.

**[0017]** Still optionally, the second planetary gear member is a planet carrier of the planetary gear carrying a plurality of planetary gear wheels. The planetary gear wheels are rotationally arranged on the planet carrier and drivingly connect the sun gear and the ring gear. This also implies a simplified configuration where the planet carrier is drivingly connected to the outer shaft via the gear wheel set. For example, the planet carrier may comprise gear teeth which are in meshing engagement with gear teeth of the gear wheel set. Still optionally, the planet carrier comprising the gear teeth for the gear wheel set may be made in one single piece, implying a robust and compact configuration.

**[0018]** Still optionally, the third planetary gear member is a ring gear of the planetary gear. This implies a facilitated connection interface between the planetary gear and the pitch controlling actuator since the ring gear is the outermost member of the planetary gear. For example, the ring gear may comprise gear teeth on a radially outer peripheral surface of the ring gear for the pitch controlling actuator. Additionally, or alternatively, the ring gear may comprise gear teeth on an axial side face of the ring gear for the pitch controlling actuator, such as an axial side face which faces away from the one or more propeller blades. Still optionally, the ring gear with the gear teeth for the pitch controlling actuator may be made in one single piece, implying a robust and compact configuration.

**[0019]** Optionally, the pitch controlling actuator is a rotary actuator, such as an electromechanical rotary actuator, which is configured to rotate the third planetary gear member with respect to the housing. Even though the pitch controlling actuator preferably is an electromechanical actuator, it shall be noted that also other actuators may be used, such as pneumatic and hydraulic actuators.

**[0020]** Optionally, the outer shaft is arranged to rotate one full revolution or more than one full revolution with respect to the propeller shaft. Thereby, the pitch angle of the one or more propeller blades may be set to any angle, i.e., an angle of 0 to 360 degrees with respect to a pitch angle rotational axis of the respective propeller blade.

**[0021]** Optionally, the pitch controlling actuator is arranged to, in the second state, actuate the third planetary gear member in any rotational direction with respect to the housing. Thereby, the pitch angle can be adjusted in any direction, implying faster and more efficient pitch angle adjustment.

**[0022]** Optionally, the gear wheel set has a fixed gear ratio which allows the propeller shaft and the outer shaft to rotate with the same rotational speed when the pitch controlling actuator is provided in the first state. A fixed gear ratio implies a simplified and compact configuration.

**[0023]** Optionally, the gear wheel set comprises a first gear wheel which is in meshing engagement with an auxiliary gear wheel of the second planetary gear member, and the gear wheel set further comprises a second gear wheel, which is rotationally fixed to the first gear wheel and which is in meshing engagement with an outer shaft gear wheel which is rotationally fixed to the outer shaft. This implies a robust and compact gear wheel set. The first and second the gear wheels may be made in one single piece. The auxiliary gear wheel may be integrated with the second planetary gear member, i.e. made in one single piece.

**[0024]** Optionally, the propeller drive arrangement further comprises a bevel gear arrangement drivingly connecting the outer shaft to the one or more propeller blades.

**[0025]** According to the invention, the propeller drive arrangement comprises only one planetary gear. This implies a compact configuration.

**[0026]** According to a second aspect of the invention, the object is achieved by a vessel according to claim 12. Thus, there is provided a vessel, such as a sailing vessel, comprising a propeller drive arrangement according to any one of the embodiments of the first aspect of the invention.

**[0027]** Advantages and effects of the second aspect of the invention are analogous to the advantages and effects of the first aspect of the invention.

**[0028]** Further advantages and advantageous features of the invention are disclosed in the following description and in the dependent claims.

## BRIEF DESCRIPTION OF THE DRAWINGS

**[0029]** With reference to the appended drawings, below follows a more detailed description of embodiments of the invention cited as examples.

**[0030]** In the drawings:

Fig. 1 is a sectional view of a propeller drive arrange-

ment according to an example embodiment of the present invention, and

Fig. 2 is a side view of a vessel according to an example embodiment of the present invention.

**[0031]** The drawings are schematic and not necessarily drawn to scale. It shall be understood that the embodiments shown and described are exemplifying and that the disclosure is not limited to these embodiments. It shall also be noted that some details in the drawings may be exaggerated in order to better describe and illustrate the disclosure. Like reference characters throughout the drawings refer to the same, or similar, type of element unless expressed otherwise.

## DETAILED DESCRIPTION OF EXAMPLE EMBODIMENTS OF THE INVENTION

**[0032]** Fig. 1 depicts a sectional view of a propeller drive arrangement 1 according to an example embodiment of the present invention. The propeller drive arrangement 1 comprises a propeller shaft 10. The sectional view is including a rotational axis A of the propeller shaft 10.

**[0033]** The propeller drive arrangement 1 comprises:

- the propeller shaft 10, and
- a propeller hub 20 comprising one or more propeller blades 22, 24, wherein a pitch angle of the one or more propeller blades 22, 24 is variable.

**[0034]** The propeller drive arrangement 1 further comprises a planetary gear 30. The planetary gear 30 comprises a first planetary gear member 32, a second planetary gear member 34 and a third planetary gear member 36 which are drivingly connected. The planetary gear 30 is coaxially arranged on the propeller shaft 10.

**[0035]** In the shown embodiment, the first planetary gear member 32 is a sun gear, the second planetary gear member 34 is a planet carrier 34 carrying a plurality of planetary gear wheels 342, and the third planetary gear member 36 is a ring gear. The planetary gear wheels 342 are rotationally arranged on the planet carrier 34 and drivingly connecting the sun gear 32 and the ring gear 36.

**[0036]** The propeller drive arrangement 1 further comprises an outer shaft 40 arranged coaxially with and radially outside of the propeller shaft 10.

**[0037]** It further comprises a gear wheel set 42 drivingly connecting the second planetary gear member 34 with the outer shaft 40.

**[0038]** The outer shaft 40 is drivingly connected to the one or more propeller blades 22, 24 for varying the pitch angle, and the propeller shaft 10, in one end 12 thereof, is configured to be drivingly connected to a propulsion unit (not shown) and, in a second end 14 thereof, is drivingly fixed to the propeller hub 20.

**[0039]** Moreover, the propeller shaft 10 is drivingly fixed to the first planetary gear member 32, and the second planetary gear member 34 is arranged to drive the outer shaft 40 via the gear wheel set 42 by a driving torque exerted on the propeller shaft 10, and the propeller drive arrangement 1 further comprises a pitch controlling actuator 50 for controlling the pitch angle of the one or more propeller blades 22, 24.

**[0040]** The pitch controlling actuator 50 is arranged to, in a first state, engage the third planetary gear member 36 to a housing (not shown) so that the propeller shaft 10 and the outer shaft 40 are arranged to rotate with the same rotational speed, and, in a second state, actuate the third planetary gear member 36 so that the third planetary gear member 36 rotates with respect to the housing.

**[0041]** More specifically, the propeller drive arrangement 1 is configured so that, when the propeller shaft 10 and the outer shaft 40 rotate with the same rotational speed, the pitch angle of the one or more propeller blades 22, 24 is fixed. In addition, it is further configured so that, when the third planetary gear member 36 rotates with respect to the housing, the pitch angle of the one or more propeller blades 22, 24 is adjusted.

**[0042]** The pitch angle of each propeller blade 22, 24 is adjusted with respect to a respective pitch angle rotational axis A2, A3 of the respective propeller blade 22, 24. The pitch angle rotational axis A2, A3 of each propeller blade 22, 24 extends along a radial direction of the propeller shaft 10.

**[0043]** Even though the shown configuration may be a preferred configuration, it shall be noted that other configurations are feasible. More specifically, by using a planetary gear 30, it has been realized that six different combinations are possible, depending on which member of the planetary gear 30 the outer shaft 40 is in driving connection with, and also depending on which other member of the planetary gear 30 the pitch controlling actuator 50 is configured to actuate.

**[0044]** As shown in fig. 1, the pitch controlling actuator 50 may be a rotary actuator, herein an electromechanical rotary actuator, which is configured to rotate the third planetary gear member 36 with respect to the housing. More specifically, in the shown embodiment, the rotary actuator 50 comprises a shaft 52 arranged to rotate with respect to a rotational axis A1 of the rotary actuator 50. The rotational axis A1 of the rotary actuator 50 is in the shown embodiment provided in parallel with the rotational axis A of the propeller shaft 10. This implies a compact configuration. It shall however be noted that other configurations are feasible, such as providing a rotary actuator having a shaft with a rotational axis which is perpendicular to the rotational axis A of the propeller shaft 10, such as a rotational axis of the rotary actuator which is aligned with a radial direction of the propeller shaft 10.

**[0045]** The rotary actuator 50 comprises an actuator gear wheel 54 provided on the shaft 52. Gear teeth of the actuator gear wheel 54 are in meshing engagement with gear teeth 362 of the ring gear 36. The gear teeth 362 are in the shown embodiment provided on a radially

outer peripheral surface of the ring gear 36.

**[0046]** Furthermore, in the shown embodiment, the outer shaft 40 is arranged to rotate one full revolution or more than one full revolution with respect to the propeller shaft 10. In other words, in the shown embodiment, the outer shaft 40 is freely rotatable with respect to the propeller shaft 10. The outer shaft 40 may be supported by bearings (not shown) provided in-between the propeller shaft 10 and the outer shaft 40. The bearings may be ball bearings or roller bearings.

**[0047]** The pitch controlling actuator 50 may be arranged to, in the second state, actuate the third planetary gear member 36 in any rotational direction with respect to the housing.

**[0048]** Accordingly, the pitch controlling actuator 50 may be arranged to, in the second state, actuate the third planetary gear member 36 in any rotational direction with respect to the rotational axis A, i.e. in a clockwise and an anti-clockwise direction. This is achieved by rotating the shaft 52 in the clockwise or the anti-clockwise direction about the rotational axis A1. Thereby, the pitch angle of the propeller blades 22, 24 can be adjusted in any direction. Accordingly, the pitch angle can thereby for example be quickly adjusted back and forth between two different angular positions. The pitch controlling actuator 50 may be controlled by a control unit (not shown) which issues control signals to the pitch controlling actuator 50.

**[0049]** The gear wheel set 42 as shown in fig. 1 has a fixed gear ratio which allows the propeller shaft 10 and the outer shaft 40 to rotate with the same rotational speed when the pitch controlling actuator 50 is provided in the first state. More specifically, as shown, the gear wheel set 42 may comprise a first gear wheel 421 which is in meshing engagement with an auxiliary gear wheel 341 of the second planetary gear member 34, and the gear wheel set 42 may further comprise a second gear wheel 422, which is rotationally fixed to the first gear wheel 421 and which is in meshing engagement with an outer shaft gear wheel 401, which is rotationally fixed to the outer shaft 40. In the shown embodiment, the first gear wheel 421 and the second gear wheel 422 are made in one single piece. In the shown embodiment, each one of the first gearwheel 421, the second gearwheel 422 and the outer shaft gearwheel 401 comprises respective gear teeth provided on a respective radially outer peripheral surface.

**[0050]** The propeller drive arrangement 1 as shown in fig. 1 further comprises a bevel gear arrangement 44 drivingly connecting the outer shaft 40 to the one or more propeller blades 22, 24. Accordingly, a rotational motion about the axis A of the outer shaft 40 relative to the propeller shaft 10 can be translated to rotational motions of the propeller blades 22, 24 with respect to the pitch angle rotational axes A2, A3.

**[0051]** As further depicted in fig. 1, the propeller drive arrangement 1 comprises only one planetary gear 30, thereby enabling a compact, low-weight and cost-effective configuration.

**[0052]** Fig. 2 depicts a side view of a vessel 100 according to an example embodiment of the invention. The vessel 100 is a marine vessel, and more particularly a sailing vessel comprising at least one sailing rig 110. The vessel 100 further comprises a propeller drive arrangement 1 according to an embodiment of the invention, such as the propeller drive arrangement 1 shown in fig. 1. The propeller drive arrangement 1 may be used for generating a propulsion force by a propulsion unit 120, such as an electric motor. The propeller drive arrangement 1 may also be used for regenerating power to an energy storage system (not shown), e.g. a battery, when the vessel 100 is using the sailing rig 110 for generating the propulsion force. By varying the pitch angle during use of the vessel 100, the regenerative power generation and/or the propulsion force can for example be optimized for improved energy efficiency.

**[0053]** 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 propeller drive arrangement (1), comprising:

- a propeller shaft (10),
- a propeller hub (20) comprising one or more propeller blades (22, 24), wherein a pitch angle of the one or more propeller blades is variable,
- a planetary gear (30) comprising a first planetary gear member (32), a second planetary gear member (34) and a third planetary gear member (36) which are drivingly connected,
- an outer shaft (40) arranged coaxially with and radially outside of the propeller shaft (10),
- a gear wheel set (42) drivingly connecting the second planetary gear member (34) with the outer shaft (40),

wherein the outer shaft (40) is drivingly connected to the one or more propeller blades (22, 24) for varying the pitch angle,
wherein the propeller shaft (10), in one end (12) thereof, is configured to be drivingly connected to a propulsion unit and, in a second end (14) thereof, is drivingly fixed to the propeller hub (20), wherein the propeller shaft (10) is drivingly fixed to the first planetary gear member (32), and wherein the second planetary gear member (34) is arranged to drive the outer shaft (40) via the gear wheel set (42) by a driving torque exerted on the propeller shaft (10), and

- the propeller drive arrangement (1) further

comprising a pitch controlling actuator (50) for controlling the pitch angle of the one or more propeller blades (22, 24),

wherein the pitch controlling actuator (50) is arranged to, in a first state, engage the third planetary gear member (36) to a housing so that the propeller shaft (10) and the outer shaft (40) are arranged to rotate with the same rotational speed, and, in a second state, actuate the third planetary gear member (36) so that the third planetary gear member (36) rotates with respect to the housing, **characterized in that**,
the propeller drive arrangement (1) comprises only one planetary gear (30).

**2.** The propeller drive arrangement (1) according to claim 1, wherein the first planetary gear member is a sun gear (32) of the planetary gear (30).

**3.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the second planetary gear member is a planet carrier (34) of the planetary gear (30) carrying a plurality of planetary gear wheels (342).

**4.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the third planetary gear member is a ring gear (36) of the planetary gear (30).

**5.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the pitch controlling actuator (50) is a rotary actuator, such as an electromechanical rotary actuator, which is configured to rotate the third planetary gear member (36) with respect to the housing.

**6.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the outer shaft (40) is arranged to rotate one full revolution or more than one full revolution with respect to the propeller shaft (10).

**7.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the pitch controlling actuator (50) is arranged to, in the second state, actuate the third planetary gear member (36) in any rotational direction with respect to the housing.

**8.** The propeller drive arrangement (1) according to any one of the preceding claims, wherein the gear wheel set (42) has a fixed gear ratio which allows the propeller shaft (10) and the outer shaft (40) to rotate with the same rotational speed when the pitch controlling actuator (50) is provided in the first state.

**9.** The propeller drive arrangement (1) according to claim 8, wherein the gear wheel set (42) comprises a first gear wheel (421) which is in meshing engagement with an auxiliary gear wheel (341) of the second planetary gear member (34), and wherein the gear wheel set (42) further comprises a second gear wheel (422), which is rotationally fixed to the first gear wheel (421) and which is in meshing engagement with an outer shaft gear wheel (401) which is rotationally fixed to the outer shaft (40).

**10.** The propeller drive arrangement (1) according to claim 9, wherein the first gear wheel (421) and the second gearwheel (422) are made in one single piece.

**11.** The propeller drive arrangement (1) according to any one of the preceding claims, further comprising a bevel gear arrangement (44) drivingly connecting the outer shaft (40) to the one or more propeller blades (22, 24).

**12.** A vessel (100), such as a sailing vessel, comprising a propeller drive arrangement (1) according to any one of the preceding claims.

**Patentansprüche**

**1.** Propellerantriebsanordnung (1), umfassend:

- eine Propellerwelle (10),
- eine Propellernabe (20), umfassend ein oder mehrere Propellerblätter (22, 24), wobei ein Einstellwinkel des einen oder der mehreren Propellerblätter variabel ist,
- ein Planetengetriebe (30), umfassend ein erstes Planetengetriebeelement (32), ein zweites Planetengetriebeelement (34) und ein drittes Planetengetriebeelement (36), die antriebsmäßig verbunden sind,
- eine Außenwelle (40) die koaxial mit und radial außerhalb der Propellerwelle (10) angeordnet ist,
- ein Zahnradsatz (42), der das zweite Planetengetriebeelement (34) mit der Außenwelle (40) antriebsmäßig verbindet,

wobei die Außenwelle (40) zum Variieren des Einstellwinkels mit dem einen oder den mehreren Propellerblättern (22, 24) antriebsmäßig verbunden ist,
wobei die Propellerwelle (10), in einem Ende (12) davon, konfiguriert ist, um mit einer Antriebseinheit antriebsmäßig verbunden zu werden, und, in einem zweiten Ende (14) davon, mit der Propellernabe (20) antriebsmäßig fixiert ist, wobei die Propellerwelle

(10) mit dem ersten Planetengetriebeelement (32) antriebsmäßig fixiert ist, und wobei das zweite Planetengetriebeelement (34) angeordnet ist, um die Außenwelle (40) über den Zahnradsatz (42) durch ein Antriebsdrehmoment, das auf die Propellerwelle (10) wirkt, anzutreiben, und

- die Propellerantriebsanordnung (1) ferner umfassend einen einstellwinkelsteuernden Stellantrieb (50) zum Steuern des Einstellwinkels des einen oder der mehreren Propellerblätter (22, 24),

wobei der einstellwinkelsteuernde Stellantrieb (50) angeordnet ist, um, in einem ersten Zustand, das dritte Planetengetriebeelement (36) mit einem Gehäuse in Eingriff zu nehmen, sodass die Propellerwelle (10) und die Außenwelle (40) angeordnet sind, um sich mit der gleichen Drehgeschwindigkeit zu drehen, und, in einem zweiten Zustand, das dritte Planetengetriebeelement (36) in Bewegung zu setzen, sodass sich das dritte Planetengetriebeelement (36) hinsichtlich des Gehäuses dreht, **dadurch gekennzeichnet, dass**,
die Propellerantriebsanordnung (1) nur ein Planetengetriebe (30) umfasst.

**2.** Propellerantriebsanordnung (1) nach Anspruch 1, wobei das erste Planetengetriebeelement ein Sonnenrad (32) des Planetengetriebes (30) ist.

**3.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei das zweite Planetengetriebeelement ein Planetenträger (34) des Planetengetriebes (30) ist, der eine Vielzahl von Planetenrädern (342) trägt.

**4.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei das dritte Planetengetriebeelement ein Hohlrad (36) des Planetengetriebes (30) ist.

**5.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei der einstellwinkelsteuernde Stellantrieb (50) ein Drehstellantrieb, wie etwa ein elektromechanischer Drehstellantrieb, ist, der konfiguriert ist, um das dritte Planetengetriebeelement (36) hinsichtlich des Gehäuses zu drehen.

**6.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei die Außenwelle (40) angeordnet ist, um sich hinsichtlich der Propellerwelle (10) eine volle Umdrehung oder mehr als eine volle Umdrehung zu drehen.

**7.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei der einstellwinkelsteuernde Stellantrieb (50) angeordnet ist, um, in dem zweiten Zustand, das dritte Planetengetriebeelement (36) in eine beliebige Drehrichtung hinsichtlich des Gehäuses in Bewegung zu setzen.

**8.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, wobei der Zahnradsatz (42) ein fixiertes Übersetzungsverhältnis aufweist, das es der Propellerwelle (10) und der Außenwelle (40) ermöglicht, sich mit der gleichen Drehgeschwindigkeit zu drehen, wenn der einstellwinkelsteuernde Stellantrieb (50) in dem ersten Zustand bereitgestellt ist.

**9.** Propellerantriebsanordnung (1) nach Anspruch 8, wobei der Zahnradsatz (42) ein erstes Zahnrad (421), das in kämmendem Eingriff mit einem zusätzlichen Zahnrad (341) des zweiten Planetengetriebeelements (34) steht, umfasst, und wobei der Zahnradsatz (42) ferner ein zweites Zahnrad (422), das mit dem ersten Zahnrad (421) drehfest fixiert ist und das in kämmendem Eingriff mit einem Außenwellenzahnrad (401) steht, umfasst, das mit der Außenwelle (40) drehfest fixiert ist.

**10.** Propellerantriebsanordnung (1) nach Anspruch 9, wobei das erste Zahnrad (421) und das zweite Zahnrad (422) aus einem einzigen Stück gefertigt sind.

**11.** Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche, ferner umfassend eine Kegelradgetriebeanordnung (44), die die Außenwelle (40) mit dem einen oder den mehreren Propellerblättern (22, 24) antriebsmäßig verbindet.

**12.** Schiff (100), wie etwa ein Segelschiff, umfassend eine Propellerantriebsanordnung (1) nach einem der vorstehenden Ansprüche.

**Revendications**

**1.** Agencement d'entraînement d'hélice (1), comprenant :

- un arbre d'hélice (10),
- un moyeu d'hélice (20) comprenant une ou plusieurs pales d'hélice (22, 24), dans lequel un angle d'inclinaison de la ou des pales d'hélice est variable,
- un engrenage planétaire (30) comprenant un premier élément d'engrenage planétaire (32), un deuxième élément d'engrenage planétaire (34) et un troisième élément d'engrenage planétaire (36) qui sont reliés par entraînement,
- un arbre extérieur (40) disposé coaxialement et radialement à l'extérieur de l'arbre d'hélice

(10),
- un jeu de roues dentées (42) reliant par entraînement le deuxième élément d'engrenage planétaire (34) à l'arbre extérieur (40),

dans lequel l'arbre extérieur (40) est relié par entraînement à une ou plusieurs pales d'hélice (22, 24) pour faire varier l'angle d'inclinaison,
dans lequel l'arbre d'hélice (10), à une de ses extrémités (12), est conçu pour être relié par entraînement à une unité de propulsion et, à une seconde de ses extrémités (14), est fixé par entraînement au moyeu d'hélice (20), dans lequel l'arbre d'hélice (10) est fixé par entraînement au premier élément d'engrenage planétaire (32), et dans lequel le deuxième élément d'engrenage planétaire (34) est conçu pour entraîner l'arbre extérieur (40) par l'intermédiaire du jeu de roues dentées (42) grâce à un couple d'entraînement exercé sur l'arbre d'hélice (10), et

- l'agencement d'entraînement d'hélice (1) comprenant en outre un élément de commande d'inclinaison (50) permettant de faire varier l'angle d'inclinaison de la ou des pales d'hélice (22, 24),

dans lequel l'actionneur de commande d'inclinaison (50) est conçu pour, dans un premier état, mettre en prise le troisième élément d'engrenage planétaire (36) dans un boîtier de sorte que l'arbre d'hélice (10) et l'arbre extérieur (40) soient conçus pour tourner à la même vitesse de rotation, et, dans un deuxième état, actionner le troisième élément d'engrenage planétaire (36) de sorte que le troisième élément d'engrenage planétaire (36) tourne par rapport au boîtier, **caractérisé par le fait que**,
le dispositif d'entraînement d'hélice (1) ne comprend qu'un seul engrenage planétaire (30).

**2.** Agencement d'entraînement d'hélice (1) selon la revendication 1, dans lequel le premier élément d'engrenage planétaire est un engrenage solaire (32) de l'engrenage planétaire (30).

**3.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel le deuxième élément d'engrenage planétaire est un support de planétaire (34) de l'engrenage planétaire (30) portant une pluralité de roues dentées planétaires (342).

**4.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel le troisième élément d'engrenage planétaire est une couronne dentée (36) de l'engrenage planétaire (30).

**5.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel l'actionneur de commande d'inclinaison (50) est un actionneur rotatif, tel qu'un actionneur rotatif électromécanique, qui est conçu pour faire tourner le troisième élément d'engrenage planétaire (36) par rapport au boîtier.

**6.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel l'arbre externe (40) est agencé pour se mettre en rotation sur une révolution complète, ou plus d'une révolution complète, par rapport à l'arbre d'hélice (10).

**7.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel l'actionneur de commande d'inclinaison (50) est conçu pour, dans le second état, actionner le troisième élément d'engrenage planétaire (36) dans n'importe quel sens de rotation par rapport au boîtier.

**8.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, dans lequel le jeu de roues dentées (42) a un rapport de multiplication fixe qui permet à l'arbre d'hélice (10) et à l'arbre extérieur (40) de tourner à la même vitesse de rotation lorsque l'actionneur de commande d'inclinaison (50) est fourni dans le premier état.

**9.** Agencement d'entraînement d'hélice (1) selon la revendication 8, dans lequel le jeu de roues dentées (42) comprend une première roue dentée (421) qui est en prise avec une roue dentée auxiliaire (341) du deuxième élément d'engrenage planétaire (34), et dans lequel le jeu de roues dentées (42) comprend en outre une deuxième roue dentée (422), qui est fixée en rotation à la première roue dentée (421) et qui est en prise avec une roue dentée de l'arbre extérieur (401) qui est fixée en rotation à l'arbre extérieur (40).

**10.** Agencement d'entraînement d'hélice (1) selon la revendication 9, dans lequel la première roue dentée (421) et la deuxième roue dentée (422) sont fabriquées en une seule pièce.

**11.** Agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes, comprenant en outre un agencement d'engrenage conique (44) reliant en entraînement l'arbre externe (40) à la ou aux pales d'hélice (22, 24).

**12.** Navire (100), tel qu'un navire à voiles, comprenant un agencement d'entraînement d'hélice (1) selon l'une quelconque des revendications précédentes.

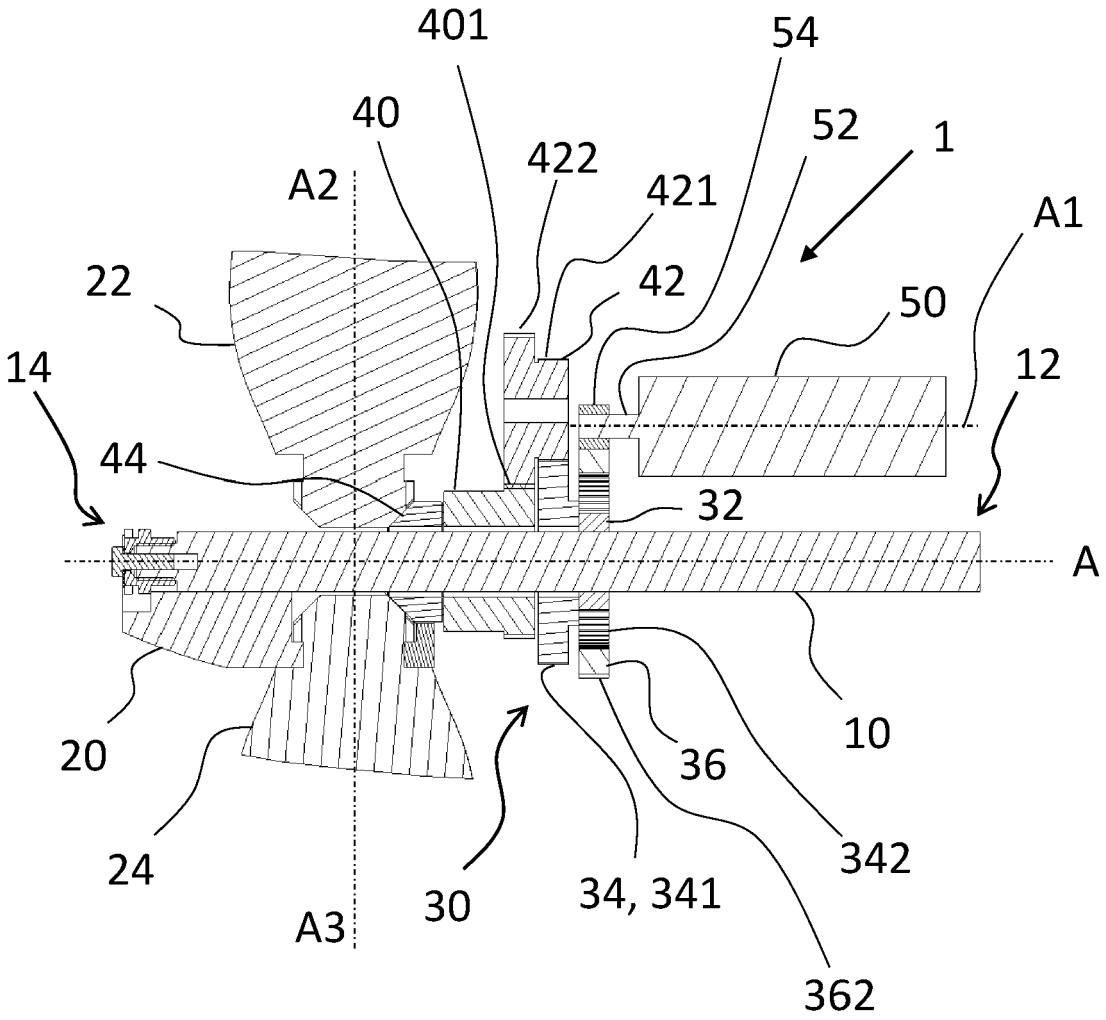

401
54
40
52
1
422
421
A2
A1
22
42
50
14
12
44
32
A
20
10
36
24
342
30
34, 341
A3
362

Fig. 1

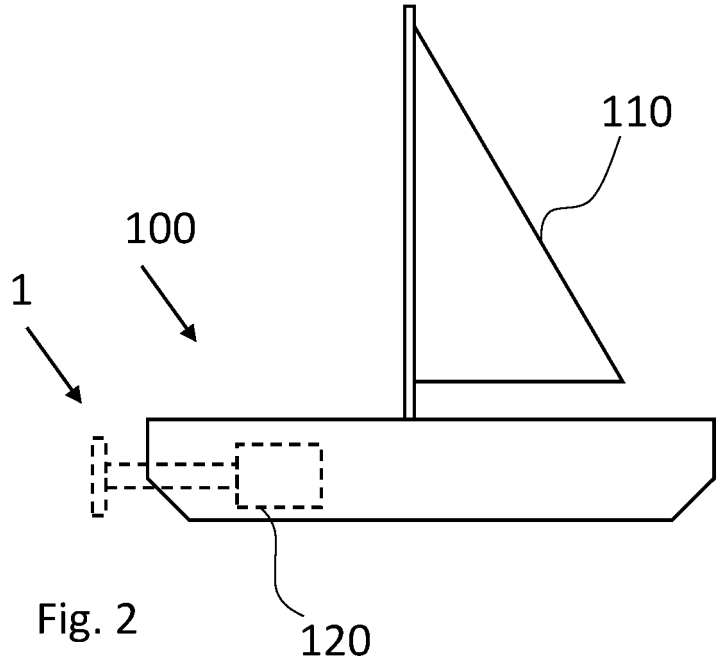



Fig. 2

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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