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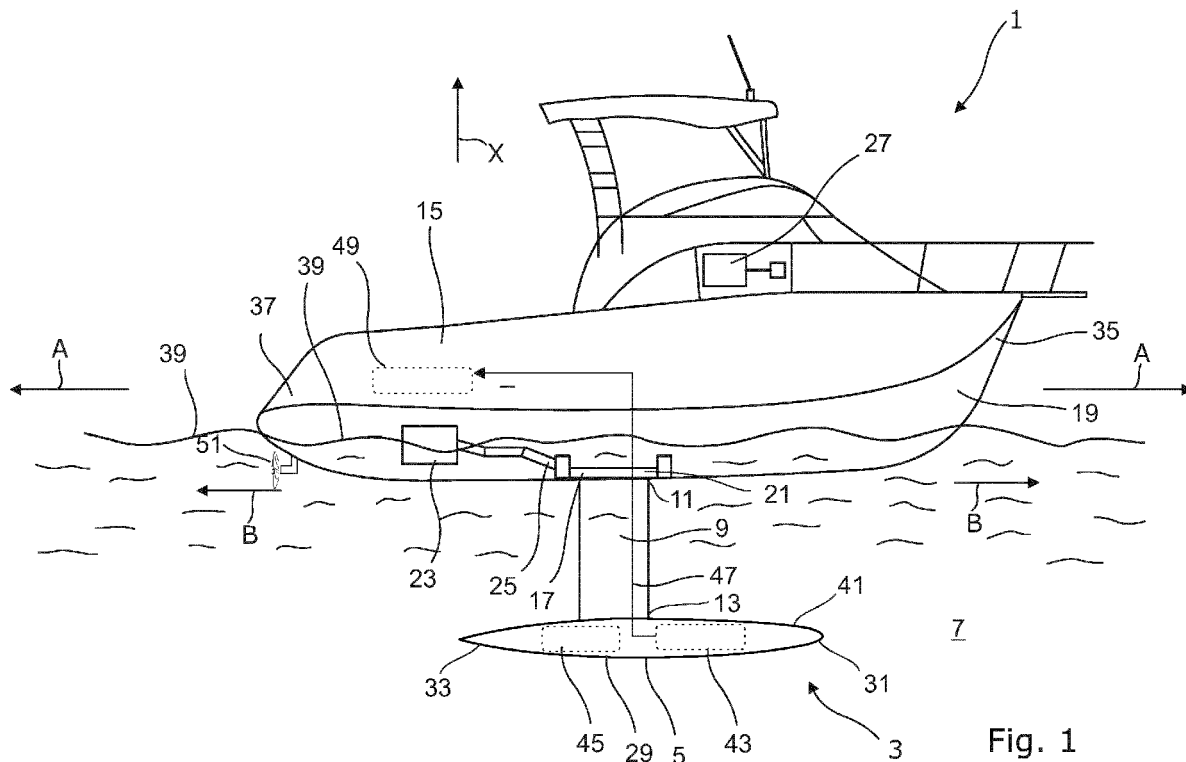
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(57) A positive buoyancy stabilisation device for a marine vessel, the positive buoyancy stabilisation device comprising a stabilisation member for providing a positive buoyancy force when submerged in a body of water, an elongated part having a first end connected with the sta-

bilisation member and a second end opposite to the first end, and a connecting part configured to connect the second end of the elongated part to a hull of a marine vessel, wherein the stabilisation member comprises a tank for storing fuel.

**Fig. 1****EP 4 349 705 A1**

Description

Technical field

[0001] A positive buoyancy stabilisation device or a marine vessel, the positive buoyancy stabilisation device comprising: a stabilisation member for providing a positive buoyancy force when submerged in a body of water.

Description

[0002] Marine vessels are often provided with motors to propel the marine vessel along the surface of a body of water, where the motors may be in the form of outboard motors or inboard engines. These outboard motors or inboard engines need a form of fuel, where internal combustion engines need to be provided with a fuel tank holding either petrol or diesel or, alternatively, with batteries, should the outboard motor or the inboard engine be in the form of an electric motor.

[0003] However, for all of these types of power needed to power an outboard motor or an inboard engine, marine vessels are provided with fuel tanks or batteries that are provided inboard of the marine vessel. Thus, the weight of the fuel and/or the batteries will affect the buoyancy of the marine vessel, as the weight of the fuel and/or the batteries will affect the displacement of the marine vessel.

[0004] However, when using an electric motor with batteries, the requirements of the battery pack of the marine vessel are significantly higher than the requirements of a fuel tank of an internal combustion engine, which means that if a marine vessel is intended to have an acceptable range, the weight of the battery pack is significant and will affect the buoyancy and stability of the marine vessel, as the positioning of the batteries may be important for the inclination stability of the marine vessel.

[0005] An alternative way of powering a marine vessel may be to have an electric motor where the electric power is provided via a fuel cell, such as a hydrogen fuel cell, a methanol fuel cell, or other types of fuel cells, where the fuel for the fuel cells is provided inside an inboard tank on the marine vessel. This means that the electric motor does not need a large battery pack requiring recharging, but can have a tank that may be filled up with the appropriate fluid to increase the range of the marine vessel.

[0006] However, the fuel for internal combustion engines and the fuel cells are often a volatile fluid, where the fluid inside an inboard tank can catch fire if the marine vessel is involved in an accident, and such a fire may be devastating to the marine vessel and fatal for any crew or passengers on the marine vessel.

[0007] Thus, there may be a need to improve the safety of marine vessels by providing the fuel for marine vessel in a safer environment that may reduce the risk of catastrophic failure or damage to the marine vessel, should an accident occur. Furthermore, there may also be a

need to improve the stability of marine vessels in order to reduce the effect that the weight of the fuel and/or the batteries may have on the roll stability and buoyancy of the marine vessel.

[0008] In accordance with the invention, there is provided a positive buoyancy stabilisation device for a marine vessel, the positive buoyancy stabilisation device comprising: a stabilisation member for providing a positive buoyancy force when submerged in a body of water, an elongated part having a first end connected with the stabilisation member and a second end opposite to the first end, and a connecting part configured to connect the second end of the elongated part to a hull of the marine vessel, wherein the stabilisation member comprises a tank for storing fuel.

[0009] Within the understanding of the present invention, the term "positive buoyancy" may mean the upwards force exerted by a fluid that opposes the weight of an immersed object. Thus, the average density of the body immersed in the fluid is less than that of the fluid which is displaced by the body. Therefore, the positive buoyancy may mean that an upwards force is applied to the stabilisation device when the device is submerged in a body of water. It may be understood that the weight of the stabilisation device and/or the stabilisation member may be adjusted to affect the upwards force of the stabilisation device and/or the stabilisation member.

[0010] The positive buoyancy stabilisation device may be partly or fully submerged in a body of water when the marine vessel is positioned on the surface of the body of water. The elongated part may be utilised to provide a distance between the hull and the stabilisation member, so that the centre of mass or centre of buoyancy of the marine vessel may be moved away or positioned away from the centre of mass or centre of buoyancy of the hull on its own. The connecting part may be attached to an outer surface of the hull, so that the elongated part and the stabilisation member are attached to the hull via the connecting part. The connecting part may be part of the elongated part and/or may be part of the hull.

[0011] The elongated member may be in the form of a hydrofoil to minimise the lateral motion of the vessel under forwards or backwards motion, where the foil shape of the elongated member may generate lift during forwards motion of the marine vessel.

[0012] The stabilisation member may be a stabilisation member that provides a positive buoyancy force, i.e. where the stabilisation member has a weight that is less than the water displaced by the stabilisation member. Thus, the stabilisation member may increase the buoyancy of the marine vessel and may be used to counteract the movements of the hull in the water, and may further be utilised to stabilise the marine vessel during use/operation.

[0013] By providing a stabilisation member that comprises a fuel tank, it may be possible to improve the safety of the marine vessel, as the fuel, which might be flammable, may be moved from being inboard of the marine

vessel to being provided in the stabilisation member that is submerged below the surface of the body of water. Thus, should the fuel tank be damaged, the risk of combustion is minimised, as the fuel may leak out to the surrounding body of water, thereby reducing the risk of the fuel coming into contact with electrical wirings, hot engine parts or any means of igniting the fuel. In that way, the fuel tank may be isolated from the hull of the marine vessel below the surface of the body of water, thereby reducing the risk of accidental combustion of the fuel, which may be a combustible fluid.

[0014] Furthermore, by positioning the fuel tank in the stabilisation member, it may be possible to lower the centre of gravity of the marine vessel, as the weight of the fuel may be arranged at a distance from the centre of gravity of the hull in a downwards direction (the direction of gravity). Thus, the stability of the hull may be increased, as an inboard fuel tank may cause an imbalance to the hull of the marine vessel, either when the tank is full or when the tank is empty, because the weight of the fuel in the tank will decrease during use as the fuel is extracted from the tank to propel the marine vessel and/or to generate electricity for the marine vessel. Any increase or decrease in the weight of the fuel inside the stabilisation member may be compensated by the stabilisation member, so that when the weight of the fuel tank decreases, the stabilisation member may be adjusted to compensate for the reduced weight. The compensation may be in the form of adding ballast water into the stabilisation member or in the form of moving the stabilisation member to adjust the upwards force of the stabilisation member due to the decrease in weight and the increase in positive buoyancy force.

[0015] The positive buoyancy stabilisation member may be a positive buoyancy keel.

[0016] In one exemplary embodiment, the fuel tank may be a high-pressure fuel tank. The high-pressure fuel tank may be a tank that is capable of holding a fluid fuel that has to be maintained under high pressure, where the pressure of the tank may be capable of holding a fuel at at least 300 bar, or may more preferably be capable of holding a fuel at at least 500 bar, or may more preferably be capable of holding a fuel at at least 600 bar, or may more preferably be capable of holding a fuel at at least 700 bar. The fuel tank may be part of a pressurised closed system, which ensures that fuel vapours from inside the tank can escape into the surroundings, where the pressure of the fuel inside the tank cannot damage the tank. The high-pressure fuel tank may be made out of metal and may have a metallic inner lining with an outer wrapping that bears the pressure of the load, or it may be made out of a composite material and have an outer wrapping made out of carbon fibre and/or other thermoplastic polymers. The tank may be provided with a safety valve, sensors or other known parts that are used for high-pressure fuel tanks. The fuel tank may have a holding capacity of at least 50 litres, or may more preferably have a holding capacity of at least 75 litres, or may

more preferably have a holding capacity of at least 100 litres, or may more preferably have a holding capacity of at least 150 litres, or may more preferably have a holding capacity of at least 300 litres.

[0017] In one exemplary embodiment, the fuel tank may be configured to comprise hydrogen or to hold hydrogen under high pressure. A hydrogen fuel tank may have a volume that is capable of holding hydrogen, where the increase and decrease in hydrogen inside the tank will not affect the buoyancy of the tank or the stabilisation member significantly. As an example, a hydrogen high-pressure storage tank having a volume of 275 litres may weigh about 130 kg, while having a holding capacity of hydrogen at around 8 kg. Thus, the maximum weight of the tank may be around 138 kg, and the minimum weight of the tank may be around 130 kg, whereas the tank may displace at least 275 litres. Accordingly, as the weight of the displaced water is much higher than the weight of the fuel tank, the fuel tank will have positive buoyancy when submerged and may assist the stabilisation member in providing a positive buoyancy force.

[0018] Alternatively, the fuel tank of the stabilisation member may have close-to-neutral buoyancy, so that other parts of the stabilisation member may be utilised to provide the positive buoyancy of the stabilisation member, such as a ballast tank. Thus, the weight of the tank is close to the volume of the tank, so that a tank that holds around 100 litres will have a weight of around 100 kg. When the fuel is added to the tank, the stabilisation member may then compensate for the weight of the fuel that is held in the tank and adjust the compensation continuously to ensure that the fuel tank and the fuel do not affect the buoyancy of the stabilisation member negatively. Alternatively, the fuel tank may have a positive buoyancy force and may assist the stabilisation member in maintaining a positive buoyancy force when submerged. Thus, a tank that can hold 100 litres may have a weight of 50 kg, and where the weight of the fuel does not exceed the combined weight of the water displaced by the fuel tank and the fuel.

[0019] By providing a hydrogen fuel tank in the stabilisation member, the high-pressure hydrogen, which is highly combustible, may be kept at a safe distance from the hull of the marine vessel by arranging the fuel tank inside the stabilisation member. Thus, if there is a leakage in the hydrogen fuel tank, the hydrogen will leak into the body of water, and the leak will be substantially harmless, as the hydrogen will be released as bubbles that will rise to the surface of the body of water and release into the atmosphere. Furthermore, if a catastrophic breach occurs in the hydrogen tank, and the hydrogen ignites and may combust, the combustion will be relatively harmless to the hull of the marine vessel, as the combustion will be below the water level of the marine vessel. Thus, there is an increase in safety by positioning the fuel cell in the submerged stabilisation member.

[0020] In one exemplary embodiment, the stabilisation member may have a plurality of fuel tanks, where each

fuel tank may have a predefined volume, and the total fuel tank volume of the stabilisation member may be the total volume of all of the fuel tanks. By providing a plurality of fuel tanks, it may be possible to improve safety, as a catastrophic failure of one tank will not affect a second tank in the stabilisation member. Thus, the catastrophic failure will only lead to the loss of a part of the total fuel volume held by the stabilisation member, as the capacity of one tank may be independent from the capacity of another tank.

[0021] In one exemplary embodiment, the hydrogen and/or the fuel of the fuel tank may be utilised for propulsion of the marine vessel. Thus, the hydrogen may be used as a fuel for providing motive power to the marine vessel, where the hydrogen may be introduced into a fuel cell to power an inboard or outboard electric motor. Fuel cells may be used to generate electricity, generally using oxygen from the air and compressed hydrogen, where the chemical energy of the hydrogen and an oxidizing agent (oxygen) is transformed into electricity through redox reactions. Thus, by providing propulsion to the marine vessel using hydrogen, the only biproduct of the propulsive power is water, which may be introduced into the surrounding water.

[0022] In one exemplary embodiment, the stabilisation member may comprise a ballast tank, where fluids may be introduced into the ballast tank and expelled from the ballast tank to adjust the buoyancy of the stabilisation member. The ballast tank may be utilised to increase or decrease the buoyancy of the stabilisation member, where water may be expelled from the tank to increase the buoyancy, and where water may be introduced into the tank to reduce the buoyancy. The ballast tank may be configured to provide the stabilisation member with a range of buoyancy extending from around neutral buoyancy where the stabilisation member and/or the stabilisation device may have neutral buoyancy and the range of buoyancy may extend to a positive buoyancy where the weight of the stabilisation member and/or the stabilisation device is significantly lower than the weight of the water displaced by the stabilisation member and/or the stabilisation device.

[0023] In one exemplary embodiment, the fuel tank may comprise a fluid input and/or a fluid output. The fuel tank may be provided with a fluid input that allows fluid fuel to be introduced into the fuel tank, and where the fuel tank will hold the fluid when the fluid has been introduced into the fuel tank. The fluid input may comprise a one-way valve, where the one-way valve ensures that the fluid fuel cannot escape the fuel tank via the fluid input, but allows the fluid fuel to be introduced into the fuel tank. Such a valve may e.g. be a high-pressure valve, where a dispenser may be attached to the fluid input which may mechanically open the valve or may alternatively provide the fluid at a pressure that is higher than an opening pressure of the valve. Thus, the valve may be a pressure valve or a mechanical valve. The fuel tank may further comprise a fluid output, where the fluid output ensures

that the fluid held inside the tank may be controllably released from the fuel tank to be utilised as a power source for a propulsion device. The fluid output may be provided with a valve that may be opened to allow the fluid to exit the fuel tank.

[0024] In one exemplary embodiment, the positive buoyancy stabilisation device may comprise a fluid input connection line connected to the fluid input. The fuel tank may be submerged beneath the surface of a body of water, which means that it may be difficult to access the fuel tank when it is submerged. Thus, the positive buoyancy stabilisation device may be provided with a fluid input connection line that may be utilised to provide fluid communication between the fuel tank and the second fluid input, where the second fluid input may be arranged inboard of the hull of the marine vessel, or may be arranged on the outside of the hull of the marine vessel. The second fluid input may be connected to a fuel pump or a fuel station, where the fluid fuel may be fed via the fluid input connection and into the fuel tank.

[0025] Furthermore, the fluid output may be connected to a fluid output connection providing a fluid connection between the fluid output and optionally a hydrogen fuel cell or a source that is capable of utilising the hydrogen fuel, such as a hydrogen internal combustion engine. The fluid output connection may provide a fluid connection between the fuel tank and a peripheral device, where the peripheral device may be in the form of a fuel cell or any kind of equipment that is capable of harvesting the chemical energy of the hydrogen and transforming it into electrical and/or mechanical power that may be utilised to propel the marine vessel. Thus, the fluid output connection may be utilised to transport fuel from the fuel tank to a power device. The fluid output connection may transport the fuel under pressure from the fuel tank, where the pressure may be provided using a pump or using an internal pressure of the fuel tank.

[0026] In one exemplary embodiment, the fluid input connection and/or the fluid output connection extend(s) from the stabilisation member to the connecting part inside the elongated member and optionally in through the hull of the marine vessel. The elongated member may have an outer surface, where the outer surface is configured to face the body of water. The fluid input connection and/or the fluid output connection may be positioned within the outer surface of the elongated member, so that the fluid input connection and/or the fluid output connection is/are positioned inside the elongated member and may extend within the elongated member along the entire length of the elongated member. Thus, the fluid connection may be protected from foreign objects, such as debris in the body of water, so that if the stabilisation device comes into contact with a foreign object, the marine vessel being at a predefined speed, the foreign object will collide with the outer surface of the elongated member, thereby reducing the risk that the fluid connection will be damaged during a collision with a foreign object. The fluid input connection and/or the fluid output connection may

provide fluid communication between the stabilisation device and the inboard part of the hull, so if the fuel cell is provided inboard of the marine vessel, the fluid connection will provide a fluid connection between the stabilisation device and the fuel cell.

[0027] The connecting part may comprise one or more parts of the first fluid connection and/or the second fluid connection, where the fluid communication channel may be part of the connecting part. Thus, if the elongated member is capable of pivoting relatively to the connecting part and/or the hull, the fluid connection may pivot accordingly, where the pivoting does not put any strain on the fluid connection.

[0028] In one exemplary embodiment, the stabilisation member may comprise a propulsion device. The stabilisation member may have an elongated form, where the longitudinal axis of the stabilisation member may extend in parallel to the direction of travel of the marine vessel. The stabilisation member may comprise a bow part and a stern part, where the bow part (front part) of the stabilisation member may be formed to reduce drag, and where the stern part (back part) may be provided with a propulsion device, such as a screw propeller or a water jet, that may have a motor directly or indirectly powered by the fuel provided in the fuel tank of the stabilisation device. Thus, it may be possible to provide increased propulsion power to the marine vessel, or the propulsion device may be utilised to neutralise the drag of the stabilisation device below the surface of the water by providing propulsion power that is equal to or exceeds the drag force of the stabilisation device and/or the stabilisation member and/or the elongated member.

[0029] In one exemplary embodiment, the connecting part may comprise a pivotal joint connected with the second end of the elongated part, so that the elongated part and/or the stabilisation member is/are configured to pivot relatively to the hull of the marine vessel. Thus, the stabilisation member may be pivotally connected with the marine vessel and may have a first pivotal axis, a stabilisation actuation device having a second longitudinal axis and configured to provide actuation to the stabilisation member to provide pivotal movement to the stabilisation member in order to pivot, one or more attachment members being configured to provide attachment between an outer surface of the hull and configured to fix the stabilisation actuation device relatively to the outer surface of the hull. The stabilisation member and/or the elongated member may pivotally move relatively to the hull of the marine vessel, where the stabilisation member pivots along a pivotal axis, where the first end may be positioned close to the pivotal axis, and the second end may be positioned distally to the pivotal axis, so that the second end travels a longer distance than the first end during pivotal movement of the stabilisation member. Thus, the second end of the elongated member may have a buoyancy body (stabilisation member) configured to provide a counterforce to the movement of the watercraft. The pivotal axis may be parallel to the longitudinal axis of the

marine vessel, so that the pivoting movement is in the direction towards the starboard and/or port, and where the stabilisation device may provide stabilisation to the marine vessel and counteract any tilting or rolling movement of the marine vessel.

[0030] The present disclosure also relates to a marine vessel comprising a positive buoyancy stabilisation device in accordance with the presently disclosed stabilisation device. The marine vessel may thereby be provided with a stabilisation device capable of providing positive buoyancy to the marine vessel, where the fuel tank is provided below the surface of the water, and where the weight of the fuel and/or the fuel tank does not have any significant influence or effect on the weight distribution of the hull of the marine vessel.

[0031] In one exemplary embodiment, the marine vessel may comprise a hydrogen fuel cell and/or an electric motor for providing propulsion to the marine vessel. Thus, the fuel tank may be configured to hold hydrogen, where the hydrogen may be used as a fuel for providing motive power to the marine vessel, and where the hydrogen may be introduced into a fuel cell to power an onboard electric motor. Fuel cells may be used to generate electricity, generally using oxygen from the air and compressed hydrogen, where the chemical energy of the hydrogen and an oxidizing agent (oxygen) are transformed into electricity through redox reactions. Consequently, by providing propulsion to the marine vessel using hydrogen, the only biproduct of the propulsive power is water, which may be introduced into the surrounding water.

Brief description of the drawings

[0032] The following is an explanation of exemplary embodiments with reference to the drawings in which:

Fig. 1 is a schematic side view of a marine vessel having a stabilisation device in accordance with the present disclosure,

Fig. 2 is a schematic front view of a marine vessel having a stabilisation device in accordance with the present disclosure,

Fig. 3 is a schematic side view of a stabilisation device in accordance with the present disclosure, and

Fig. 4 is a system diagram of a stabilisation device in accordance with the present disclosure.

Detailed description

[0033] Various exemplary embodiments and details are described below, with reference to the figures when relevant. It should be noted that the figures may or may not be drawn to scale and that elements of similar structures or functions are represented by like reference numerals throughout the figures. It should also be noted

that the figures are only intended to facilitate the description of the embodiments. They are not intended as an exhaustive description of the disclosure or as a limitation on the scope of the disclosure. In addition, an illustrated embodiment needs not have all the aspects or advantages shown. An aspect or an advantage described in conjunction with a particular embodiment is not necessarily limited to that embodiment and can be practised in any other embodiments even if not so illustrated, or if not so explicitly described.

[0034] Fig. 1 shows a schematic side view of a marine vessel 1 having a positive buoyancy stabilisation device 3 ("stabilisation device 3"), where the stabilisation device 3 comprises a stabilisation member 5 providing a positive buoyancy force Z in an upwards direction when submerged in a body of water 7. The stabilisation device 3 further comprises an elongated member 9 having a first end 11 and a second end 13, where the first end 11 is connected with (to) the stabilisation member 5, and the opposite second end 13 is connected with a hull 15 of the marine vessel 1. The elongated member 9 has a predefined length, where the length of the elongated member 9 may be seen as defining a distance d1 between the stabilisation member 5 and the hull 15.

[0035] In this embodiment, the second end 13 of the elongated member 9 is connected to a connecting part 17, where the connecting part 17 provides a connection between the elongated member 9 and the hull 15 of the marine vessel 1. The connecting part 17 may be positioned on an outer surface 19 of the hull 15, where the elongated member 9 extends in a direction away from the outer surface 19 of the hull 15. The stabilisation member 5 may be pivotally connected with the hull 15 and may be connected via a pivotal connection 21 to the outer surface 19 of the hull 15, allowing the stabilisation member 5 to pivot along a pivotal axis B in a starboard direction and/or a port direction, as shown in Fig. 2.

[0036] The stabilisation member 5 and the elongated member 9 may be connected to a drive unit 23, e.g. via a transmission 25, where the drive unit 23 may be a motor and optionally an electric motor. The transmission 25 may be adapted to transfer a force from the drive unit 23 towards the elongated member 9, where the force may be used to manoeuvre the elongated member 9 from a first position to a second position and/or may alternatively be used to maintain the current position of the elongated member 9. The drive unit 23 (control unit) may be connected to a processing unit 27, where the processing unit 27 provides a control output which is configured to control the drive unit 23 and to provide instructions to the drive unit 23 in order to change or maintain the position of the elongated member 9. The processing unit 27 may be a CPU or similar electrical equipment, where the processing unit 27 may be utilised to gather information and, based on that information, provide a control output to control the movement of the elongated member 9.

[0037] The stabilisation member 5 may have a first body 29, where the first body 29 has a first end 31 and

a second end 33, the first body 29 having a longitudinal axis C extending from the first end 31 to the second end 33. The longitudinal axis C may be parallel to a longitudinal axis A of the marine vessel 1, where the longitudinal axis A of the marine vessel 1 extends from a bow 35 of the marine vessel 1 to a stern 37 of the marine vessel 1. The first body 29 may have a shape that is intended to provide low drag in the body of water 7 when the marine vessel 1 travels along a surface 39 of the body of water 7 in a forwards or backwards direction.

[0038] The first body 29 may have a first volume, where the volume of the first body 29 may be defined by an outer periphery 41 of the first body 29. The stabilisation member 5 may further comprise a fuel tank 43, where the fuel tank 43 may be positioned within the first volume of the first body 29, so that the fuel tank 43 is positioned inside the stabilisation member 5. The stabilisation member 5 may further comprise a ballast tank 45, where the ballast tank 45 may be utilised to adjust the buoyancy of the stabilisation member 5 and/or the stabilisation device 3, thereby adjusting the magnitude of the positive buoyancy force Z in an upwards direction. The fuel tank 43 may have a fluid output connection 47 which is configured to transport fuel from the fuel tank 43 to a power generation source 49, where the power generation source 49 may be an internal combustion engine or a fuel cell. The power generation source 49 may thereby be configured to provide direct or indirect power to a propulsion device 51, where the fuel (petrol, diesel, hydrogen) may be utilised directly by an internal combustion engine, or where the fuel may be utilised indirectly by an electric motor which uses a fuel cell to convert the chemical energy of a fuel to electrical energy that drives an electric motor that provides mechanical force to the propulsion device 51.

[0039] Fig. 2 is a front view of the marine vessel 1 shown in Fig. 1 having a port side 53 and a starboard side 55, where the outer surface of the hull 15 is provided with the stabilisation member 5, which is connected to the outer surface 19 of the hull 15 via the pivotal connection 21. The stabilisation member 5 may be the positive buoyancy body (first body) 29 connected via the elongated member 9, where the stabilisation member 5 may be moved from a first position D1 to a second position D2, using the drive unit 23 to provide mechanical force to move the stabilisation member 5. The movement of the stabilisation member 5 may be used to maintain the absolute roll position of the hull 15 in the body of water 7 when waves 57 hit the outer surface 19 of the hull 15, and to maintain the angle between a vertical axis D and a transverse axis E of the hull 15. Thus, the roll of the body in a starboard direction X or in a port direction Y may be minimised by a movement from D1 to D2 (or vice versa) of the stabilisation member 5 to counteract the movement of the hull 15 when hit by the wave(s) 57. Alternatively, the stabilisation member 5 may be utilised to counteract any external force applied to the hull 15, such as wind or weight of cargo (not shown) inboard of the hull 15.

[0040] Fig. 3 shows the stabilisation device 3 seen from the side according to the present disclosure, where the stabilisation device 3 comprises the stabilisation member 5, the elongated member 9, the connecting part 17 having the pivotal connection 21 that has the pivotal axis B, and where the stabilisation member 5 has the longitudinal axis C parallel to the pivotal axis B. The stabilisation member 5 and/or the stabilisation device 3 is/are configured to provide a positive buoyancy force Z in an upwards direction. In this embodiment, the stabilisation member 5 may be provided with the fuel tank 43, where the fuel tank 43 is a hydrogen fuel tank that is capable of holding fuel under high pressure. The stabilisation member 5 may be provided with a propulsion screw 59, where the propulsion screw 59 is connected to an electric motor 61 which may be powered by a fuel cell (not shown) that may be positioned in the stabilisation member 5 or may be provided inboard of the marine vessel 1, where the fluid output connection 47 carries the fuel from the fuel tank 43 to a fuel cell, and where an electric connection 63 which is in electrical communication with the fuel cell (not shown) provides power to the electric motor 61, which in turn transforms the electric power to mechanical power to drive the propulsion screw 59. The fuel tank 43 may further be provided with an input fluid connection 65 which may be utilised to carry fuel from a filling station and into the fuel tank 43.

[0041] Fig. 4 is a system diagram of the marine vessel 1 having the stabilisation device 3 in accordance with the present disclosure, where the fuel tank 43 may be a hydrogen fuel tank. The marine vessel 1 may comprise the hull 15, where the hull 15 may comprise a fuel cell 67, and an electric motor 69 to drive the propulsion device 51, where the fuel cell 67 may further be connected to the electric motor 69 and/or a power storage device 71 to provide an energy buffer to the fuel cell 67, and where the power storage device 71 may be connected with the electric motor 69. The elongated member 9 may be connected to the hull 15, where the stabilisation member 5 may be connected with the elongated member 9. The stabilisation member 5 comprises the fuel tank 43, where the fuel tank 43 may be a fuel tank capable of carrying hydrogen under high pressure. The marine vessel 1 may comprise the input fluid connection 65, where the input fluid connection 65 is connected with a filling part 73 which is intended to allow the filling of fuel into the fuel tank 43 via the input fluid connection 65 which is connected to the fuel tank 43. The marine vessel 1 further comprises the fluid output connection 47 which provides fluid communication between the fuel tank 43 and the fuel cell 67. The input fluid connection 65 and the fluid output connection 47 may be positioned inside the elongated member 9 to extend from the stabilisation member 5 into the hull 15 of the marine vessel 1.

[0042] The stabilisation member 5 may further be provided with the ballast tank 45, where the ballast tank 45 may be connected with a pump 75 configured to provide a fluid connection to a surrounding body of water to allow

the filling and emptying of the ballast tank 45 to control the buoyancy of the stabilisation member 5 and the stabilisation device 3.

[0043] The use of the terms "first", "second", "third" and "fourth", "primary", "secondary", "tertiary", etc., does not imply any particular order, but are included to identify individual elements. Moreover, the use of the terms "first", "second", "third" and "fourth", "primary", "secondary", "tertiary", etc., does not denote any order or importance, but rather the terms "first", "second", "third" and "fourth", "primary", "secondary", "tertiary", etc., are used to distinguish one element from another. Note that the words "first", "second", "third" and "fourth", "primary", "secondary", "tertiary", etc., are used here and elsewhere for labelling purposes only and are not intended to denote any specific spatial or temporal ordering.

[0044] Furthermore, the labelling of a first element does not imply the presence of a second element and vice versa.

[0045] It is to be noted that the word "comprising" does not necessarily exclude the presence of other elements or steps than those listed.

[0046] It is to be noted that the words "a" or "an" preceding an element do not exclude the presence of a plurality of such elements.

[0047] It should further be noted that any reference signs do not limit the scope of the claims.

[0048] Although features have been shown and described, it will be understood that they are not intended to limit the claimed invention, and it will be made obvious to those skilled in the art that various changes and modifications may be made without departing from the spirit and scope of the claimed invention. The specification and drawings are, accordingly, to be regarded in an illustrative rather than restrictive sense. The claimed invention is intended to cover all alternatives, modifications, and equivalents.

List of references

[0049]

1	Marine vessel
3	Stabilisation device
5	Stabilisation member
7	Body of water
9	Elongated member
11	First end of elongated member
13	Second end of elongated member
15	Hull
17	Connecting part
19	Outer surface of hull
21	Pivotal connection
23	Drive unit
25	Transmission
27	Processing unit
29	First body
31	First end of first body

33 Second end of first body
 35 Bow of marine vessel
 37 Stern of marine vessel
 39 Surface of the body of water
 41 Outer periphery
 43 Fuel tank
 45 Ballast tank
 47 Fluid output connection
 49 Power generation source
 51 Propulsion device
 53 Port side of marine vessel
 55 Starboard side of marine vessel
 57 Wave
 59 Propulsion screw
 61 Electric motor
 63 Electric connection
 65 Input fluid connection
 67 Fuel Cell
 69 Electric motor
 71 Power storage device
 73 Filling part
 75 Pump
 d1 Length of elongated member
 A Longitudinal axis of the marine vessel
 B Pivotal axis of stabilisation device
 C Longitudinal axis of stabilisation member
 D Vertical axis of hull
 E Transverse axis of hull
 X Starboard direction
 Y Port direction
 Z Positive buoyancy force
 D1 First position of buoyancy body
 D2 Second position of buoyancy body

Claims

1. A positive buoyancy stabilisation device for a marine vessel, the positive buoyancy stabilisation device comprising:

- a stabilisation member for providing a positive buoyancy force when submerged in a body of water,
- an elongated part having a first end connected with the stabilisation member and a second end opposite to the first end, and
- a connecting part configured to connect the second end of the elongated part to a hull of a marine vessel,

wherein the stabilisation member comprises a tank for storing fuel.

2. A positive buoyancy stabilisation device in accordance with claim 1, wherein the tank is a high-pressure tank.

3. A positive buoyancy stabilisation device in accordance with claim 2, wherein the tank comprises hydrogen.

5 4. A positive buoyancy stabilisation device in accordance with claim 3, wherein the hydrogen is utilised for propulsion of the marine vessel.

10 5. A positive buoyancy stabilisation device in accordance with any of the preceding claims, wherein the stabilisation member comprises a ballast tank, where fluids may be introduced into the ballast tank and expelled from the ballast tank to adjust the buoyancy of the stabilisation member.

15 6. A positive buoyancy stabilisation device in accordance with any of the preceding claims, wherein the tank comprises a fluid input and/or a fluid output.

20 7. A positive buoyancy stabilisation device in accordance with any of the preceding claims, wherein the positive buoyancy stabilisation device comprises a fluid input connection line connected to the fluid input and a fluid output connection providing a fluid connection between the fluid output and a hydrogen fuel cell.

25 8. A positive buoyancy stabilisation device in accordance with claim 7, wherein the fluid input connection and/or the fluid output connection extend(s) from the stabilisation member and to the connecting part inside the elongated member, and optionally in through the hull of the marine vessel.

30 9. A positive buoyancy stabilisation device in accordance with any of the preceding claims, wherein the stabilisation member comprises a propulsion device.

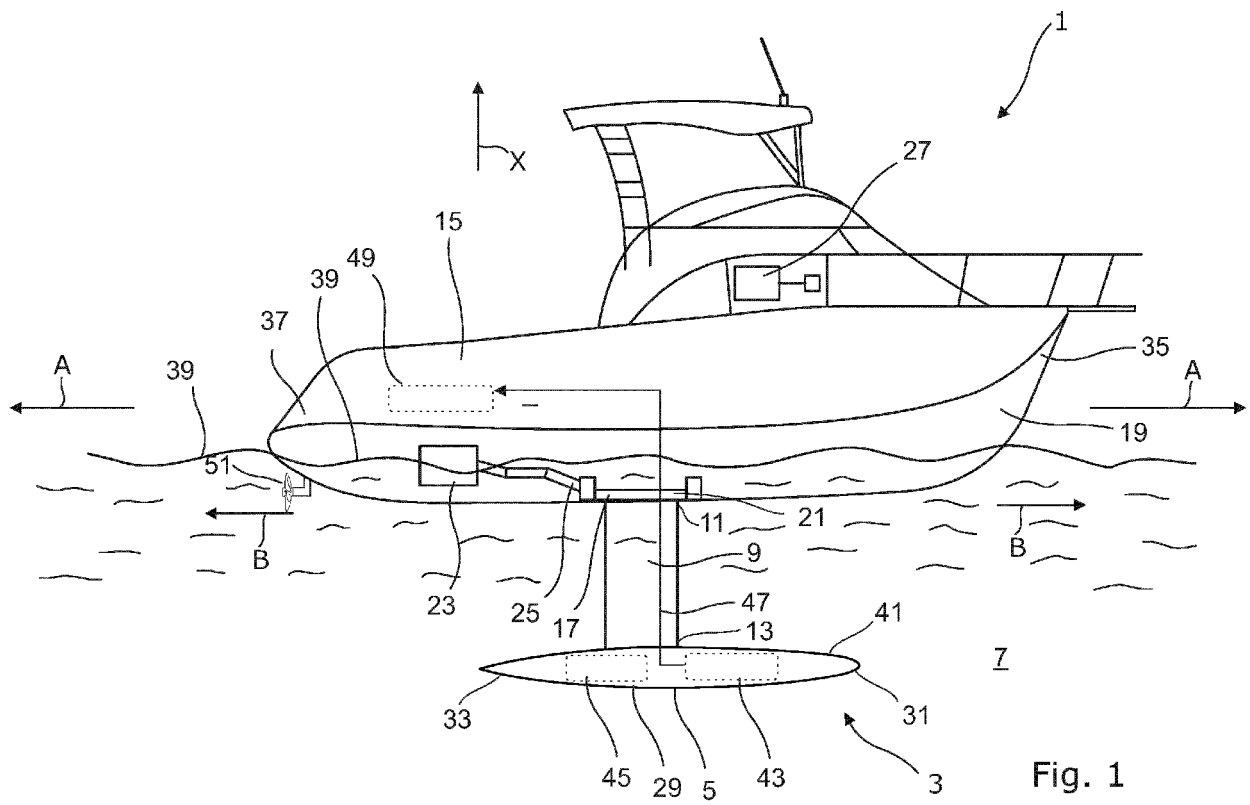
35 10. A positive buoyancy stabilisation device in accordance with any of the preceding claims, wherein the connecting part comprises a pivotal joint connected with the second end of the elongated part, so that the elongated part and/or the stabilisation member is/are configured to pivot relatively to the hull of the marine vessel.

40 11. A marine vessel comprising a positive buoyancy stabilisation device in accordance with claims 1-10.

45 12. A marine vessel in accordance with claim 11, wherein the marine vessel comprises a hydrogen fuel cell and/or an electric motor for providing propulsion to the marine vessel.

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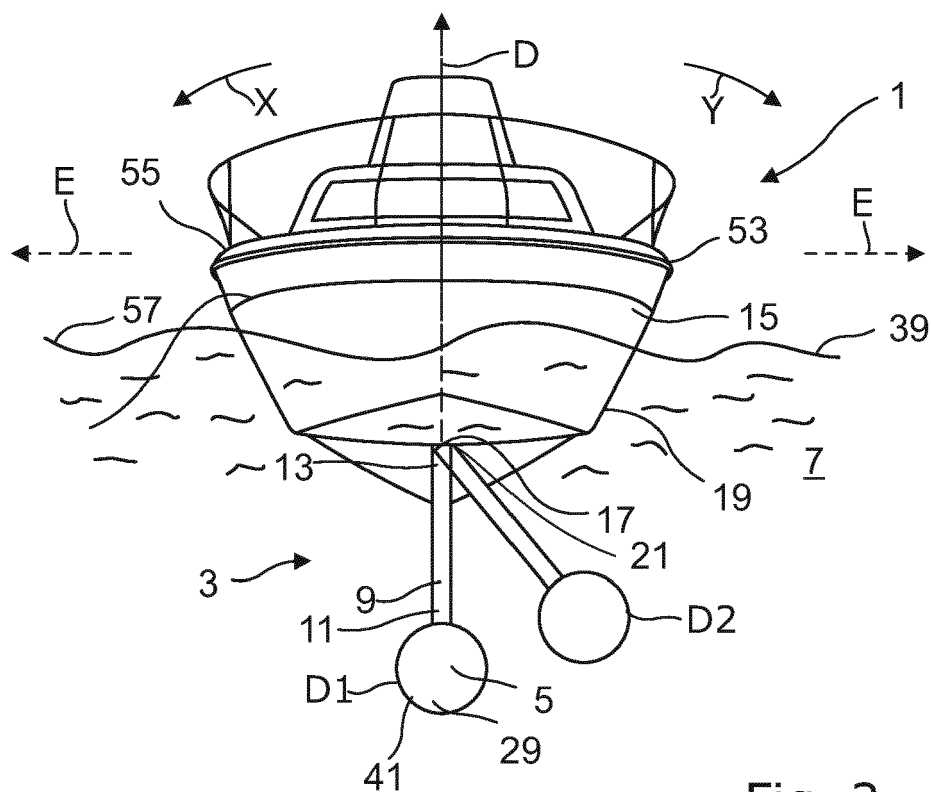


Fig. 2

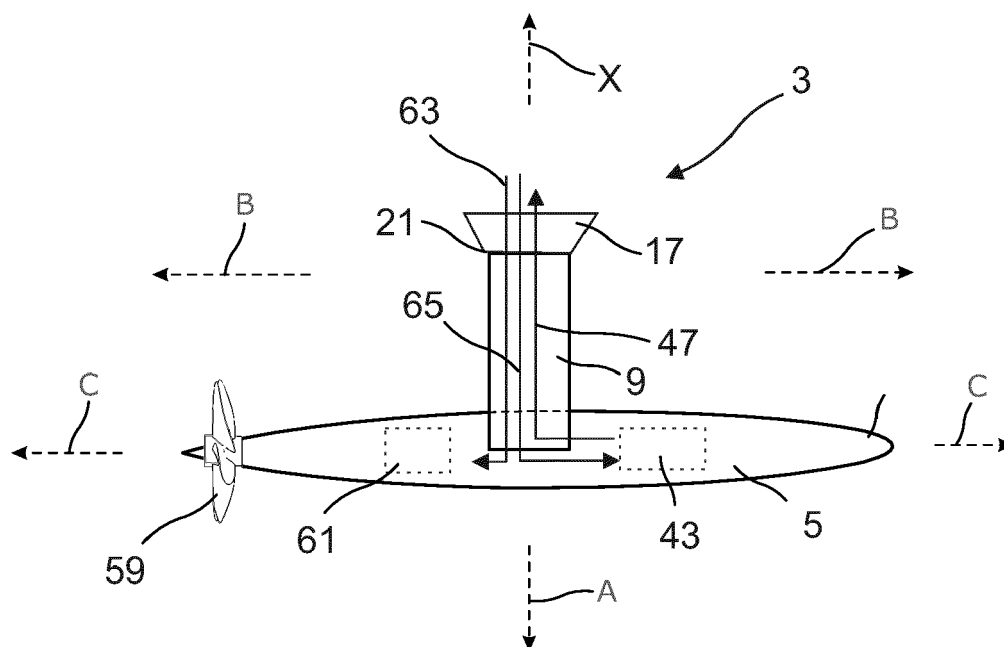


Fig. 3

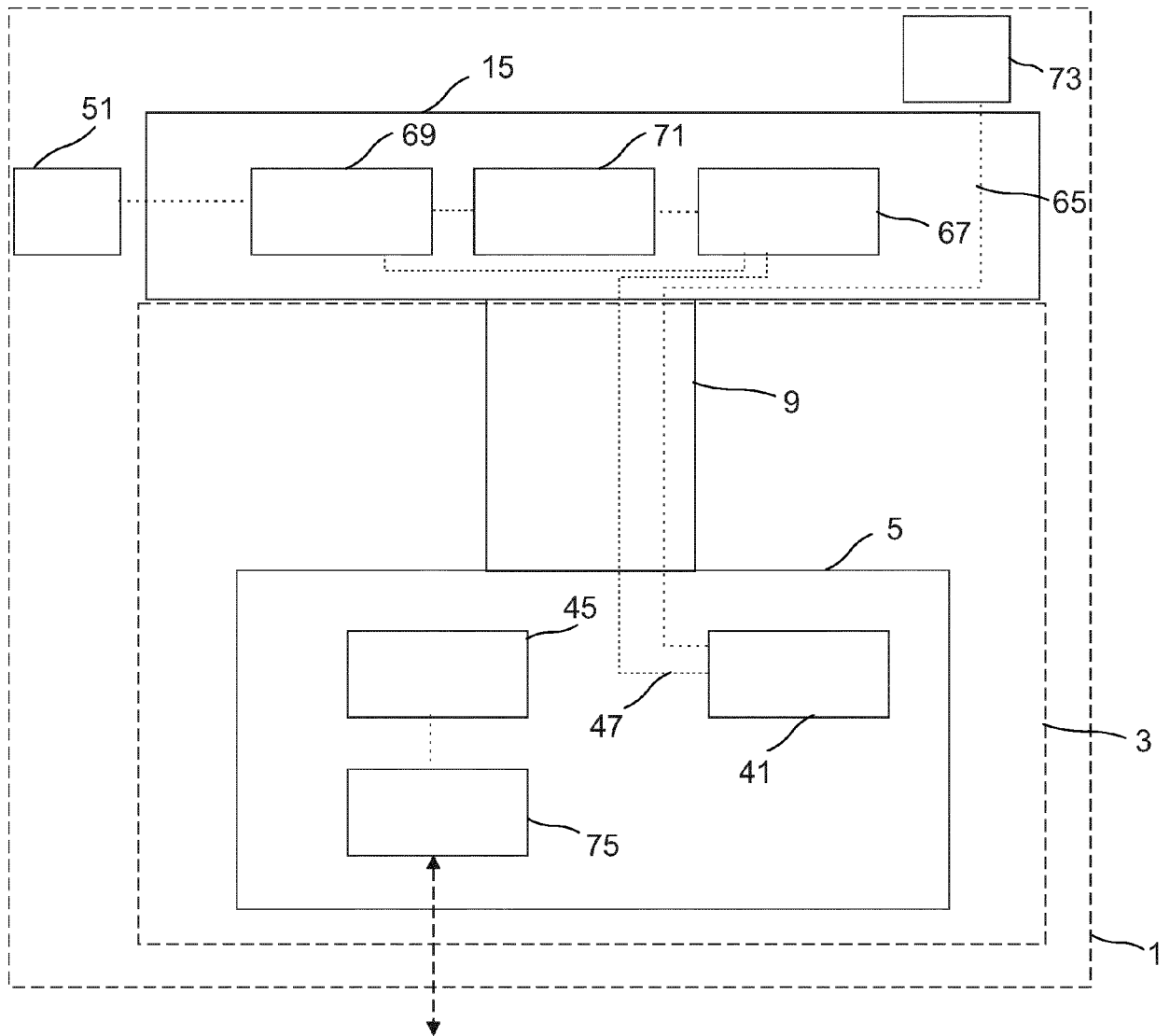


Fig. 4



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Application Number

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