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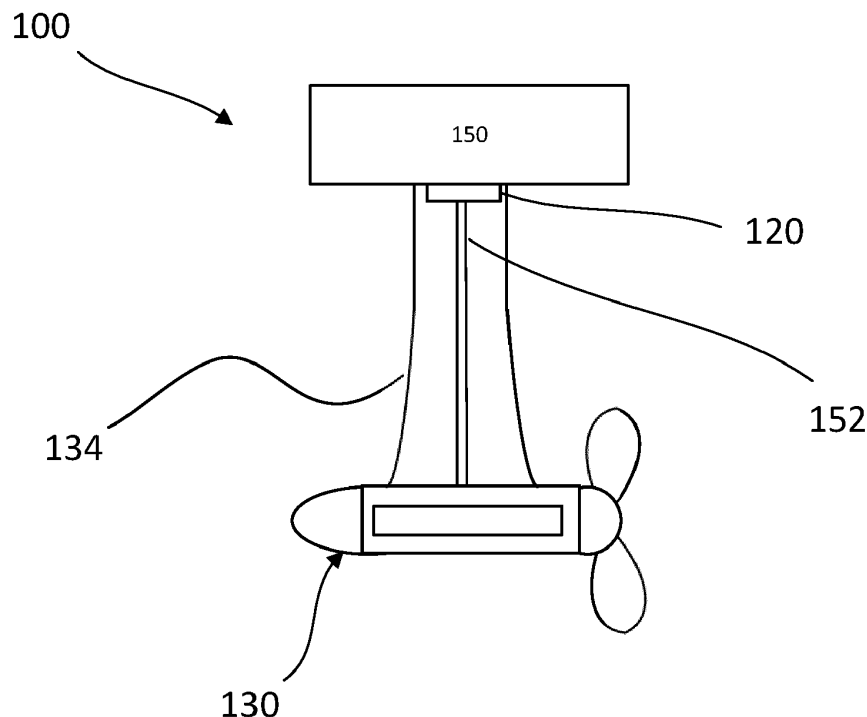
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(54) **A MARINE DRIVE UNIT**

(57) An electrical drive system (100) for a marine vessel (1) is provided. The system comprises an electric machine (130) arranged below a water level (w), an inboard electrical energy storage system (150), wherein the electric machine (130) is connected to the inboard

electrical energy storage system (150) via at least one electric cable (152), and at least one cable cutter (120) arranged to cut the at least one electric cable (152) in the event of impact. A marine vessel is also provided.

**FIG. 3A**

Description

TECHNICAL FIELD

[0001] The disclosure relates generally to a drive unit. In particular aspects, the disclosure relates to a marine drive unit for a marine vessel. The disclosure can be applied to marine vessels, such as water crafts, motor-boats, work boats, sport vessels, boats, ships, among other vessel types. Although the disclosure may be described with respect to a particular marine vessel, the disclosure is not restricted to any particular marine vessel.

BACKGROUND

[0002] Electrical drive units for propulsion and maneuvering of marine vessels are known in the art. Sometimes marine vessels encounter external obstacles, such as for example a rock or a log, that causes a severe impact on the vessel and its drive system. It would be beneficial to minimize that the damages on the marine vessel during severe impacts on the drive system. Furthermore, it would be beneficial to provide a safer system that ensures that the electrical system has been switched of in such an impact in order to reduce the risk of electrically related accidents.

SUMMARY

[0003] According to a first aspect of the disclosure, an electrical drive system for a marine vessel is provided. The drive system comprises an electric machine arranged below a water level, an inboard electrical energy storage system wherein the electric machine is connected to the inboard electrical energy storage system via at least one electric cable, and at least one cable cutter arranged to cut the at least one electric cable in the event of impact. The first aspect of the disclosure may seek to provide a safe system in the event of a high external force acting on the system, such as for example an impact from a rock or log. A technical benefit may include providing a safe way of separating the electrical wires from the different parts. It is beneficial to be able to separate the electric machine from the rest of the system in the event of a severe impact, as it prevents the electric machine from hanging after and pulling/jerking in the electrical cables. A controlled behavior of the electrical cables are thus beneficial.

[0004] Optionally in some examples, including in at least one preferred example, the electrical drive system is further comprising an elongate housing which encapsulates at least an electric motor of the electric machine. A technical benefit may include proving a housing that protects the electric motor of external conditions such as water and external forces. The elongate housing further provides a pod solution, which has many known benefits.

[0005] Optionally in some examples, including in at

least one preferred example, the elongate housing has a distal end portion. The distal end portion may be cone-shaped. A technical benefit may include providing a streamlined body that is hydrodynamic.

5 [0006] Optionally in some examples, including in at least one preferred example, the electrical drive system further comprises a mechanical switch. The cable cutter may be activated by said mechanical switch upon impact. A technical benefit may include providing a mechanical activation that works even if the electricity of the system has been deactivated.

10 [0007] Optionally in some examples, including in at least one preferred example, the switch is arranged in said distal end portion. A technical benefit may include an early onset of the switch as the distal end portions is exposed to an external pressure.

15 [0008] Optionally in some examples, including in at least one preferred example, the electrical drive system further comprising a fixture arranged to connect the electric machine and the inboard electrical energy storage system, wherein the at least one electric cable is arranged in said fixture. A technical benefit may include protection of the at least one electric cable from external conditions. The fixture may also be referred to as the drive leg.

20 [0009] Optionally in some examples, including in at least one preferred example, the cable cutter is arranged in said fixture. A technical benefit may include that the cable cutter is protected from external conditions. Moreover, a technical benefit may include that it is arranged adjacent to the cable, thus facilitating the cut.

25 [0010] Optionally in some examples, including in at least one preferred example, the cable cutter is activated once the fixture is deformed due to said impact. A technical benefit may include an early onset of the activation of the cable cutter. Moreover, a technical benefit may include decreasing the risk of incorrect activation.

30 [0011] Optionally in some examples, including in at least one preferred example, the cable cutter is mechanically driven. A technical benefit may include that the cable cutter is operational even if the electricity of the system has been deactivated.

35 [0012] Optionally in some examples, including in at least one preferred example, the cable cutter comprises a spring-loaded part. A technical benefit may include being cost-effective while at the same time being efficient and reliable.

40 [0013] Optionally in some examples, including in at least one preferred example, the cable cutter comprises a guillotine cutter. A technical benefit may include being cost-effective while at the same time being efficient and reliable.

45 [0014] Optionally in some examples, including in at least one preferred example, the cable cutter is configured to be arranged in a passive state and an active state, wherein the cable cutter is put in the active state in the event of an impact. A technical benefit may include that the cable cutter is active only when needed, i.e. when an

impact has occurred.

[0015] According to a second aspect, a marine propulsion system for a marine vessel, comprising an electrical drive system of the first aspect is provided.

[0016] According to a third aspect, a marine vessel comprising an electrical drive system of the first aspect and/or a marine propulsion system according to the second aspect is provided. A technical benefit may include providing a marine vessel that is safe to use in the event of a severe impact.

BRIEF DESCRIPTION OF THE DRAWINGS

[0017] Examples are described in more detail below with reference to the appended drawings.

FIG. 1 is an exemplary marine vessel according to an example.

FIG. 2 is an exemplary electrical drive system for a marine vessel according to an example.

FIGS. 3A-B are exemplary electrical machines in a marine drive system according to different examples.

FIGS. 4A-E are exemplary views of cable cutters according to different examples.

FIGS. 5A-B are exemplary views of cable cutters according to different examples.

FIG. 6A-B are exemplary set of electrical cables according to different examples.

DETAILED DESCRIPTION

[0018] The detailed description set forth below provides information and examples of the disclosed technology with sufficient detail to enable those skilled in the art to practice the disclosure.

[0019] **FIG. 1** is an exemplary marine electrical drive system **100** according to an example. The drive system is configured to be comprised on a marine vessel **1**. The marine drive system **100** comprises an electrical machine **130** and an electrical energy storage system **150**. In the example, the electrical machine **130** is an electric pod drive. The electric machine **130** is arranged below a water level **w**. The electrical machine **130** comprises an electric motor **140** which is connected with the energy storage system **150**. The energy storage system **150** is arranged onboard the marine vessel **1**. The energy storage system **150** may be a battery pack.

[0020] The inventors of the present invention has realized that there is a need to have a last-resort safety function in the case that the marine vessel **1** is encountering a high impact (for example by hitting a rock) that is deforming or in other way destroying parts of the electrical drive system **100**. A cable cutter **120** configured to cut at least one electric cable that is connecting the electrical machine **130** and the electrical energy storage system **150** is thus provided. By cutting the cable(s) at a high impact the damages caused can be reduced. Cut-

ting the cables allows the electrical machine **130** to be separated from the marine vessel. Before turning into details regarding the cutter **120** the other parts of the system will be described. In one example, the cable cutter **120** is positioned such the cables are cut in a way so they don't interfere when the drive leg/fixture is disconnected from the upper part of the system. In one example, the cable cutter **120** is arranged such that the drive leg (fixture) or parts of the drive leg is torn away from the vessel in a well-defined breach. This reduces the risk of breaking the vessel so that it starts taking in water. In other words, the cables are cut so that they are not pulled out during an impact causing a mess.

[0021] Some marine vessels are arranged with emergency switches, that electronically deactivates the electrical circuits in the system. However, the inventors of the present invention has realized that it is beneficial to also be able to cut the cable(s) so that the mechanical connection ceases to exist. In this way, the electrical machine, arranged under water, can be cut free from the rest of the marine vessel. The mechanical cut of the cable also ensures that no electrical faults occurs that could trigger other accidents, such as for example an electrical fire.

[0022] **FIG. 2** shows an exemplary electric machine **130**. The electric machine **130** comprises an electric motor **140**. The electric motor **140** is driving a drive shaft **142**. The electric machine **130** further comprises at least one propeller **132**. The electric motor **140** is configured to drive the propeller **132**. The electric motor **140** may be directly connected with the propeller or it may be indirectly connected with propeller **132**. A shaft **142** may be arranged between the electric motor **140** and the propeller **132** for providing torque and rotation to the propeller **132**. The propeller **132** is detachably mounted to the drive shaft **142**. The propeller **132** may be interchangeable.

[0023] Moreover, a transmission may be arranged between the electric motor **140** and the propeller **132** for ensuring that the intended torque is provided to the propeller **132**. In addition, the propeller **132** may be connected with the shaft **142** via a propeller hub **133**, or the electric motor **140** is directly connected to the propeller hub.

[0024] In the example, the propeller **132** has two blades **132a**, **132 b**. In other examples the propeller may have three or four blades. Other number of blades are also possible.

[0025] The propeller **132** may be a pusher propeller. The drive system is mounted to the structure onboard the vessel in such a direction that the pusher propeller **132** appears in an astern direction of the vessel.

[0026] The propeller **132** may be a puller propeller. The drive system is mounted to the structure onboard the vessel in such a direction that the puller propeller **132** appears in a forward direction of the vessel.

[0027] The propeller **132** may be a folding propeller, having a folded position and an unfolded position. The folded position is a closed position where a minimum of

drag is provided, and the unfolded position is an open position where a maximum of thrust, when used in a driving mode to provide propulsion to the marine vessel.

[0028] The control unit **135** is operatively connected with the electric motor **140**. The control unit **135** is configured to control the electric motor **140** to apply torque to the propeller **132**.

[0029] The electric machine **130** further comprises an elongate housing **131** that encapsulates at least the electric motor **140**. In a preferred example, the elongate housing **131** further encapsulates the drive shaft **142**.

[0030] The elongate housing **131** may have distal end portions **131a**, **131b**. The distal end portions **131a**, **131b** may be identical to each other, or differ from each other. The distal end portions **131a**, **131b** may be cone-shaped. The distal end portions **131a**, **131b** may include a material that protects other elements in or inside the housing **131** from galvanic corrosion in water. Such a material may be a sacrificing anode material, for example zinc, aluminum or magnesium alloys.

[0031] The elongate housing **131** is connected to a drive leg **134**. The drive leg will herein after be referred to a fixture **134**. The fixture **134** is arranged on an upper side of the elongate housing **131** and extending up to the energy storage system **150**. The fixture **134** may extend from the pod arrangement up to the hull attachment. In other words, the fixture covers the part of the system that is arranged in the water and that is between the pod arrangement and the hull. The fixture (drive leg) **134** connects to the boat's structure, possibly via a steering mechanism. A steering mechanism may be used if the drive is to be rotated around a vertical axis to steer the boat and direct the thrust of the propeller. As soon will be discussed more in detail, this is the portion of the fixture that will be disconnected from the vessel upon a severe impact.

[0032] Although not illustrated, the fixture **134** may be arranged with an inverter. If the inverter is arranged in the fixture **134** it will be arranged close to the motor, which is preferable. If the inverter is arranged in the fixture, electrical cables may be arranged from the battery(s), via the cutter **120**, to the inverter, and then from the inverter to the electric motor.

[0033] In some examples the inverter is instead arranged on the vessel, and not in the pod arrangement or in the fixture. If the inverter is arranged in the vessel electrical cables may be arranged from the inverter, via the cutter, to the electric motor.

[0034] The marine drive system **100** may also comprises a control unit **135**. In the exemplary illustration of **FIG. 2**, the control unit **135** is arranged in the electric machine **130**. However, the control unit **135** may be arranged in other parts of the drive system **100**. Moreover, the drive system **100** may comprises a plurality of control units.

[0035] The electric motor **140** may have diagnostic data such as revolutions per minute (rpm) and/or armature currents (torque). The control unit **135** may be con-

figured to monitor the diagnostic data received from the electric motor **140**. Moreover, a speed log, a true water speed sensor, a wind speed sensor and/or a positioning unit may be operatively connected with the control unit **135**. The speed log, the true water speed sensor, the wind speed sensor and/or the positioning unit may provide sensor data. The positioning unit may be a Global Positioning System (GPS).

[0036] In addition, an inertial navigation system may also be operatively connected with the control unit. The inertial navigation system may provide inertial measurement sensor data. The control unit **135** may be configured to compare the diagnostic data from the electric motor **140** with sensor data of any of the speed log, the true water speed sensor, the wind speed sensor and/or the positioning unit. Also, the control unit **135** may be configured to compare the diagnostic data from the electric motor **140** with the inertial measurement sensor data and/or the positioning data from a positioning unit.

[0037] In addition, the control unit **135** may be configured to combine the diagnostic data received from the electric motor **140** and sensor data so as to present the combined data via a user interface comprising presentation and control elements, such as displays, actuators, buttons, levers and smart device apps via gateways for protocols such as Bluetooth and Wi-Fi. Hereby, the captain or operator of the marine vessel **1** may be presented with information about the current generated power at a given speed, etc.

[0038] **FIGS. 3A-B** are exemplary marine electrical drive system **100** according to two examples. As soon will be discussed in detail, the two examples differ in the position of the at least one cutter **120**.

[0039] The inboard electrical energy storage system **150** is connected to the electric machine **130** via at least one electric cable **152**. In the example, one cable is present however it should be understood by a person skilled in the art that it could be a plurality of cables. This is also illustrated in **FIGS. 6A-B**. The cables could be arranged in a bundle of cables or as separate independent cables. The electrical cable provides electrical power supply to the electric motor **140**. The electrical cable may further be used to transmit signals and data between the electric machine **130** and the inboard electrical energy storage system **150**.

[0040] The cable **152** may be arranged through an opening in the fixture **134** that is arranged between the electrical energy storage system **150** and the electrical machine **130**. In one example, the fixture **134** is a non-solid structure, so that the cables may run freely inside the fixture. The cable(s) are connected by cable connectors. The cable connectors may be rigid solutions. The cable connectors may be arranged where the fixture (drive leg) **134** connects to the boat's structure.

[0041] The cable cutter **120** is used to cut the at least one cable **152** once the system recognize an impact acting on the vessel. If such an impact occurs, the cable cutter **120** cuts at least the cable connecting the electric

motor **140** and the inboard electrical energy storage system **150**. The cable cutter **120** thus mechanically switches the electrical system off, at least partially. In a preferred example, the cable cutter **120** acts mechanically on the at least one cable **152**.

[0042] As shown in the illustrative example of **FIG. 3A**, the at least one cutter **120** is arranged on a lower side of the inboard electrical energy storage system **150**. The lower side is to be seen as the side facing the water level **w**. The at least one cutter **120** may be arranged inside the fixture **131**.

[0043] As shown in the illustrative example of **FIG. 3B**, the at least one cutter **120** is arranged on an upper side of the inboard electrical energy storage system **150**. The upper side is to be seen as the side facing away from the water level **w**. The at least one cutter **120** may be arranged inside the inboard electrical energy storage system **150**.

[0044] The cable cutter **120** may have a plurality of different designs. This is illustrated in **FIGS. 4A - 4G**.

[0045] In the illustrative example of **FIG. 4A**, the cable cutter **120** comprises at least one blade **123** arranged to cut the cable **135**. The at least one blade **123** is at least partly arranged in a main body **121**. The main body **121** is arranged with an opening **122**. In this example the opening is a hole. The opening **122** is preferably of such dimension that the at least one cable **135** is able to be arranged therein. During normal operation, when no impact has occurred, the at least one cable **135** is arranged therein in a way that does not damage the cable (i.e. without putting too much pressure on the cable).

[0046] The blade **123** has two end portions **123a**, **123b**. The first end portion **123a** is arranged to cut the cable **135**. The first end portion **123a** is at least partly arranged in the opening **122**. The second end portion **123b** is arranged opposite the first end portion **123b**.

[0047] In the present example, the blade **123** is movably arranged in the body **121**. The blade **123** is movable in the direction as indicated by the arrow. The blade **123** is movable towards the opening **122** of the body **121**. Once the blade **123** is moved, the at least one cable **135** will be cut by the blade **123** it will be clamped within the opening and the blade **123**.

[0048] In the example of **FIG. 4B**, the body **121** of the cutter **120** is divided in two sections **121a**, **121b**. The two sections **121a**, **121b** are connected by at least one hinge **124**. The at least one hinge **124** allows the upper section **121b** to be opened in order to easier arranged the at least one cables therein. However, as should be understood the cables **135** could also be fed through the opening during manufacturing process.

[0049] In the example of **FIG. 4C**, the main body **121** is arranged with two blades **123**, **125**. The two blades **123**, **125** are opposing blades arranged opposite each other. Each blade **123**, **125** is arranged to cut the cable, either alone or in combination with the other blade. The two blades are preferably arranged on different heights. In this way, the first blade **123** is arranged to be arranged

slightly above the second blade **124**, or *vice versa*. This is illustrated in the enlarged view of **FIG. 4C**.

[0050] In the examples of **FIGS. 4A-C**, the first end portion of the blade/blades may have a rounded shape.

5 The shape is preferably concave. This is best shown in **Fig. 4C**.

[0051] **FIG. 4D** illustrates one embodiment of a cable cutter **120**. The cable cutter has two blades **123a**, **123b**. The blades are connected to two handle portions **127**. The handle portions **127** may be connected by a spring **128**. The cable cutter **120** is activated by applying a force onto the handles so that they are pressed together. In this example the cable cutter **120** acts as a scissor or pruning shears.

10 [0052] **FIG. 4E** illustrates a similar cable cutter **120** as in **FIG. 4D**. In this example, the cable cutter further comprises a supporting surface **129**. The supporting surface helps keep the cables inside the cutter.

[0053] In one embodiment, the cable cutter **120** according to all above examples, is configured to be arranged in a passive state and an active state. In the passive state, the blade **123** is not cutting the cable(s). The passive state is the normal configuration during use of the marine vessel **1**. In the active state, the blade(s) is cutting the cable(s) by moving the blade(s). Hence, in the active state the movement of the blade(s) is activated. The active state of the cable cutter **120** should only be used in situations where a severe impact on the vessel has occur. The cable cutter **120** will mechanically cut the connection between the electric machine **130** and the inboard electrical energy storage system **150**. Once the cable cutter **120** is used, the cables will have to be replaced in order to drive the marine vessel once more.

[0054] In the above examples, the movement of the blade **123** (i.e. the active state of the cutter) may be activated in several ways. As in the examples of **FIGS. 4A-C**, the blade **123** may be activated upon a force acting on the end portion **123b** of the blade **123**. The force may be generated by a spring, piston, or other structure **126** that activates during an impact, this is illustratively shown in **FIGS. 5A-B**.

[0055] The end portion **123b** of the blade could be activated, i.e. start to move, once the fixture **134** is deformed. The deformation of the fixture **134** may generate a direct force on the end portion **123b** of the blade **123**, or generate an indirect force on the end portion **123b** of the blade **123**, for example via a structure **126** such as a spring etc.. In one embodiment, the end portion **123b** of the blade could be activated based on a force generated once a switch is activated.

[0056] **FIGS. 5A-B** illustrates a cutter **120** with a structure **126** that activates the at least one blade **123** during direct or indirect impact according to two examples. As mention above, the structure **126** could for example be a loaded spring or a piston. This is illustrated in **FIG. 5A**.

[0057] Yet further, the cable cutter could be driven and activated by a structure being an ignition system **126**. This is illustratively shown in **FIG. 5B**. The ignition system

126 may initiate a chemical reaction upon impact (either by the force generated or indirectly by a switch) that produces gas and inflates an activator **126b**. The activator **126b** adds a force to the cable cutter **120** thus putting it in an active mode. In one example, the activator **126b** activates a structure **126a** that causes a force onto the blade(s) **123**. In one example the ignition system comprises a squib, a small igniter that produces a spark, a canister containing sodium axide, and a stable compound that rapidly decomposes when subjected to high temperatures.

[0058] As should be understood by a person skilled in the art, other types of cable cutters **120** could be used. For example, the cable cutter could for example be driven by compressed air. The cable cutter could also be electrically driven.

[0059] As have been briefly discussed above, the cable cutter **120** may be connected to at least one switch **122**. If the switch **122** is triggered, the cutter **120** is activated. The switch **122** is preferably arranged on the elongate housing **131**. In one embodiment, one switch **122** is arranged on a distal end portion **131a** of the elongate housing **131**. As should be understood, the one or more switches may be arranged at other positions as well that are suitable to detect an impact. It should be noted that the switch **122** may be arranged on the fixture **134**. Moreover, the system **100** may comprise a plurality of switches **122** arranged at different positions. In one example, one switch **122** is arranged on the housing **131** and one switch is arranged on the fixture **134**.

[0060] The switch **122** may be a mechanical impact switch. If any mechanical force acts on the vessel **1** in excess of a predetermined threshold value, the cutter **120** is activated by the switch. The elongate housing **131**, on which the switch is arranged, is deformed by the impact, whereupon the switch is triggered.

[0061] It should be noted that in some examples the cable cutter **120** is suitable to cut one single cable. In that case, the electrical drive system may comprise several cable cutters **120**. Other configurations are also possible, where for example the system comprises two cable cutters where one cable cutter **120** is arranged to cut two cables and one cable cutter **120** is arranged to cut one cable.

[0062] FIGS. 6A - B are two exemplary top views of cables **152** arranged between the inboard electrical energy storage system **150** is connected to the electric machine **130**. In the example of FIG. 6A, a first cable **152a** is a power cable, the second and third cables **152b**, **152c** are control cables. In this example, the power cable **152a** has a wider dimension than the control cables **152b**, **152c**. Here, the cables are arranged adjacent to each other in a group-like manner. As indicated by the dotted line, the plurality of cables could be arranged in a main cable **152d** that encloses the other cables.

[0063] In the example of FIG. 6B, a first cable **152a** is a power cable, the second and third cables **152b**, **152c** are control cables. In this example, all cables have the same

cross-sectional diameter. In this example, the cables are arranged side-by-side.

[0064] The cable(s) **152** may be a power cable that carry high-voltage electricity. The power cable may for example utilize a cross-linked polyethylene insulation (XLPE) that offers good resistance to moisture. The at least one cable **152** could also, or alternatively, be a control cable that transmit signals and data between the different units and/or a monitoring cables that provides continuous monitoring of various parameters (such as for example, temperature, pressure and vibration). Such cable could for example be a fiber optic cable. The cable may further be a communication cable that facilitates communication between the different units. The cable(s) **152** should be suitable to be used in water. The cable(s) could also be referred to as at least one power supply line.

[0065] In one example, the system comprises three cables, one power cable and two control cables having a smaller dimension than the power cables. The system further comprises one cable cutter **120** arranged to cut the power cable, and one cable cutter arranged to cut the two control cables. It is beneficial if the cable cutters are of suitable dimensions for the cables they are arranged to cut. Hence, in this example the cable cutter used to cut the power cables is bigger in dimension than the cable cutter used to cut the control cables.

[0066] A method of activating the cable cutter will now be described. The marine vessel is receiving an external force, causing an impact on the vessel. This may generate different actions, as will be described below.

[0067] In one example, the fixture connecting the electrical energy storage system and the electric machine is deformed. The deformation of the fixture causes a force onto the at least one cable cutter. This force puts the cable cutter into an active state. In the active state, the cable cutter cuts the at least one cable connecting the electrical energy storage system and the electric machine.

[0068] In one example, the housing of the electric machine is receiving a force. The force causes a deformation on the electric machine. The deformation of the housing causes a force onto the at least one cable cutter. This force puts the cable cutter into an active state. In the active state, the cable cutter cuts the at least one cable connecting the electrical energy storage system and the electric machine.

[0069] In one example, the fixture connecting the electrical energy storage system and the electric machine and the housing of the electrical machine is deformed. The deformation causes an activation of the cable cutter, so that the cable cuts at least one cable.

[0070] In one example, the housing of the electric machine is receiving a force. The force activates a switch arranged on the housing. The activation of a switch causes a force onto the at least one cable cutter. This force puts the cable cutter into an active state. In the active state, the cable cutter cuts the at least one cable connecting the electrical energy storage system and the electric machine.

[0071] In one example, the fixture connecting the electrical energy storage system and the electric machine is receiving a force. The force activates a switch arranged on the fixture. The activation of a switch causes a force onto the at least one cable cutter. This force puts the cable cutter into an active state. In the active state, the cable cutter cuts the at least one cable connecting the electrical energy storage system and the electric machine.

[0072] In one example, a plurality of switches, arranged at different parts in the system, causes the activation of the cutter.

[0073] Certain aspects and variants of the disclosure are set forth in the following examples numbered consecutive below.

[0074] Example 1: An electrical drive system (100) for a marine vessel (1), comprising: an electric machine (130) arranged below a water level (w), an inboard electrical energy storage system (150), wherein the electric machine (130) is connected to the inboard electrical energy storage system (150) via at least one electric cable (152); and at least one cable cutter (120) arranged to cut the at least one electric cable (152) in the event of impact.

[0075] Example 2: The electrical drive system (100) of example 1, further comprising an elongate housing (131) which encapsulates at least an electric motor (140) of the electric machine (130).

[0076] Example 3: The electrical drive system (100) of example 2, wherein the elongate housing (131) has a distal end portion (131a).

[0077] Example 4: The electrical drive system (100) of example 3, wherein the distal end portion (131a) is cone-shaped.

[0078] Example 5: The electrical drive system (100) of any of the preceding examples, further comprising a mechanical switch (122), wherein the cable cutter (120) is activated by said mechanical switch (122) upon impact.

[0079] Example 6: The electrical drive system (100) of example 3 and 5, wherein the switch (122) is arranged in said distal end portion (131a).

[0080] Example 7: The electrical drive system (100) of any of the preceding examples, further comprising a fixture (134) arranged to connect the electric machine (130) and the inboard electrical energy storage system (150), wherein the at least one electric cable (152) is arranged in said fixture (134).

[0081] Example 8: The electrical drive system (100) of example 7, wherein the cable cutter (120) is arranged in said fixture (134).

[0082] Example 9: The electrical drive system (100) of example 7 or 8, wherein the cable cutter (120) is activated once the fixture is deformed due to said impact.

[0083] Example 10: The electrical drive system (100) of any of the preceding examples, wherein the cable cutter (120) is mechanically driven.

[0084] Example 11: The electrical drive system (100) of any of the preceding examples, wherein the cable cutter (120) comprises a spring-loaded part.

[0085] Example 12: The electrical drive system (100) of any of the preceding examples, wherein the cable cutter (120) comprises a guillotine cutter.

[0086] Example 13: The electrical drive system (100) of any of the preceding examples, wherein the cable cutter (120) is configured to be arranged in a passive state and an active state, wherein the cable cutter (120) is put in the active state in the event of an impact.

[0087] Example 14: The electrical drive system of any of the preceding examples, wherein the cutter is arranged adjacent to the inboard electrical energy storage system.

[0088] Example 15: The electrical drive system of any of the preceding examples, wherein the inboard electrical energy storage system is a battery.

[0089] Example 16: The electrical drive system of any of the preceding examples, wherein the cable cutter comprises at least one blade.

[0090] Example 17: The electrical drive system of any of the preceding examples, wherein the cable cutter is arranged to cut all electrical cables.

[0091] Example 18: The electrical drive system of any of the examples 1 - 16, further comprising at least a first cable cutter and a second cable cutter and at least a first cable and a second cable, where the first cable cutter is arranged to cut the first cable and the second cable cutter is arranged to cut the second cable.

[0092] Example 14: A marine propulsion system for a marine vessel, comprising an electrical drive system (100) according to any of the preceding examples.

[0093] Example 15: A marine vessel (1) comprising an electrical drive system (100) of any of the examples 1 to 13 and/or a marine propulsion system according to example 14.

[0094] The terminology used herein is for the purpose of describing particular aspects only and is not intended to be limiting of the disclosure. As used herein, the singular forms "a," "an," and "the" are intended to include the plural forms as well, unless the context clearly indicates otherwise. As used herein, the term "and/or" includes any and all combinations of one or more of the associated listed items. It will be further understood that the terms "comprises," "comprising," "includes," and/or "including" when used herein specify the presence of stated features, integers, actions, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, actions, steps, operations, elements, components, and/or groups thereof.

[0095] It will be understood that, although the terms first, second, etc., may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and, similarly, a second element could be termed a first element without departing from the scope of the present disclosure.

[0096] Relative terms such as "below" or "above" or

"upper" or "lower" or "horizontal" or "vertical" may be used herein to describe a relationship of one element to another element as illustrated in the Figures. It will be understood that these terms and those discussed above are intended to encompass different orientations of the device in addition to the orientation depicted in the Figures. It will be understood that when an element is referred to as being "connected" or "coupled" to another element, it can be directly connected or coupled to the other element, or intervening elements may be present. In contrast, when an element is referred to as being "directly connected" or "directly coupled" to another element, there are no intervening elements present.

[0097] Unless otherwise defined, all terms (including technical and scientific terms) used herein have the same meaning as commonly understood by one of ordinary skill in the art to which this disclosure belongs. It will be further understood that terms used herein should be interpreted as having a meaning consistent with their meaning in the context of this specification and the relevant art and will not be interpreted in an idealized or overly formal sense unless expressly so defined herein.

[0098] It is to be understood that the present disclosure is not limited to the aspects 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 present disclosure and appended claims. In the drawings and specification, there have been disclosed aspects for purposes of illustration only and not for purposes of limitation, the scope of the disclosure being set forth in the following claims.

Claims

1. An electrical drive system (100) for a marine vessel (1), comprising:
 - an electric machine (130) arranged below a water level (w);
 - an inboard electrical energy storage system (150), wherein the electric machine (130) is connected to the inboard electrical energy storage system (150) via at least one electric cable (152); and
 - at least one cable cutter (120) arranged to cut the at least one electric cable (152) in the event of impact.
2. The electrical drive system (100) of claim 1, further comprising an elongate housing (131) which encapsulates at least an electric motor (140) of the electric machine (130).
3. The electrical drive system (100) of claim 2, wherein the elongate housing (131) has a distal end portion (131a).
4. The electrical drive system (100) of claim 3, wherein the distal end portion (131a) is cone-shaped.
5. The electrical drive system (100) of any of the preceding claims, further comprising a mechanical switch (122), wherein the cable cutter (120) is activated by said mechanical switch (122) upon impact.
6. The electrical drive system (100) of claim 3 and 5, wherein the switch (122) is arranged in said distal end portion (131a).
7. The electrical drive system (100) of any of the preceding claims, further comprising a fixture (134) arranged to connect the electric machine (130) and the inboard electrical energy storage system (150), wherein the at least one electric cable (152) is arranged in said fixture (134).
8. The electrical drive system (100) of claim 7, wherein the cable cutter (120) is arranged in said fixture (134).
9. The electrical drive system (100) of claim 7 or 8, wherein the cable cutter (120) is activated once the fixture is deformed due to said impact.
10. The electrical drive system (100) of any of the preceding claims, wherein the cable cutter (120) is mechanically driven.
11. The electrical drive system (100) of any of the preceding claims, wherein the cable cutter (120) comprises a spring-loaded part.
12. The electrical drive system (100) of any of the preceding claims, wherein the cable cutter (120) comprises a guillotine cutter.
13. The electrical drive system (100) of any of the preceding claims, wherein the cable cutter (120) is configured to be arranged in a passive state and an active state, wherein the cable cutter (120) is put in the active state in the event of an impact.
14. A marine propulsion system for a marine vessel, comprising an electrical drive system (100) according to any of the preceding claims.
15. A marine vessel (1) comprising an electrical drive system (100) of any of the claims 1 to 13 and/or a marine propulsion system according to claim 14.

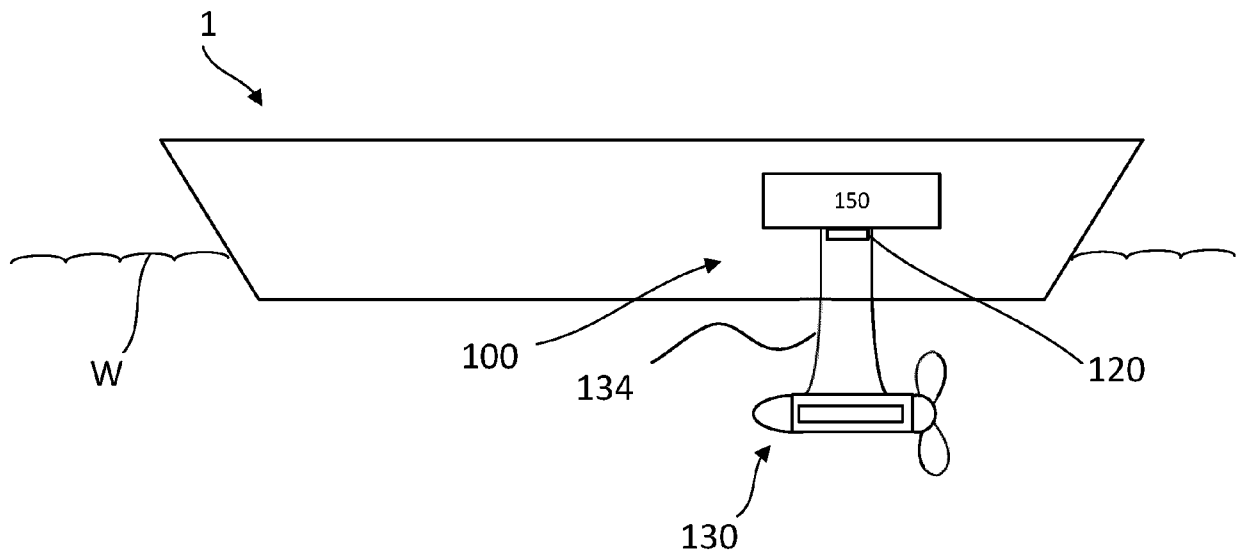


FIG. 1

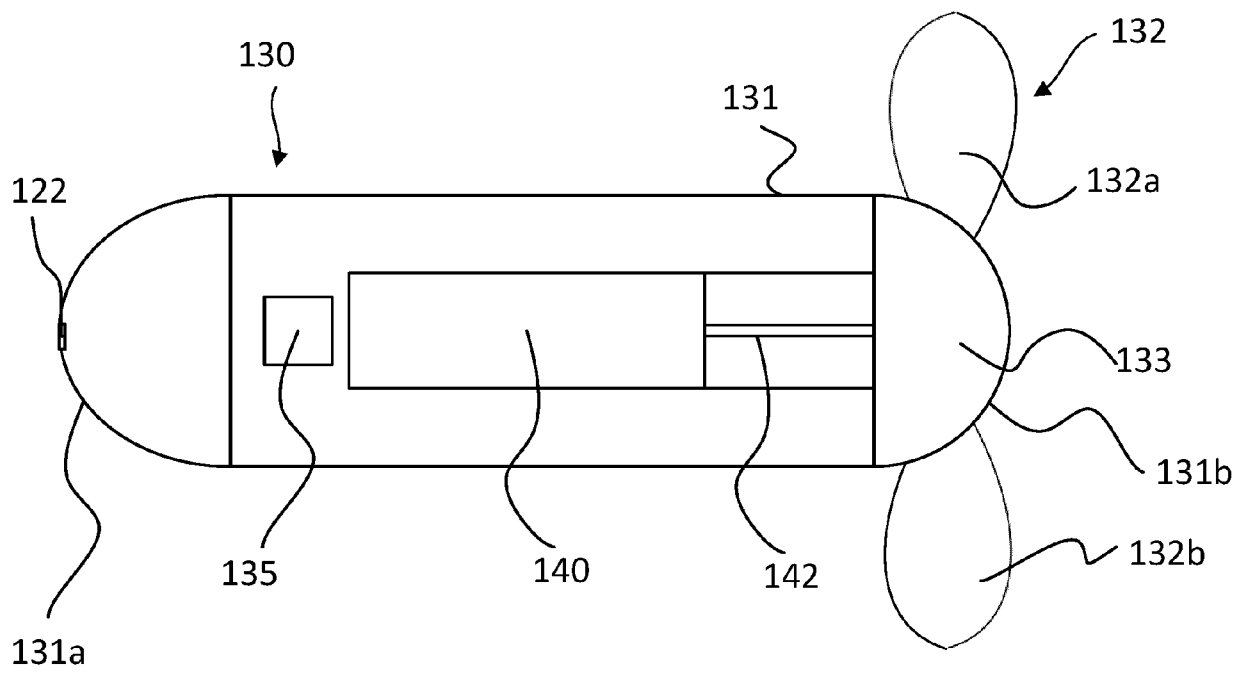


FIG. 2

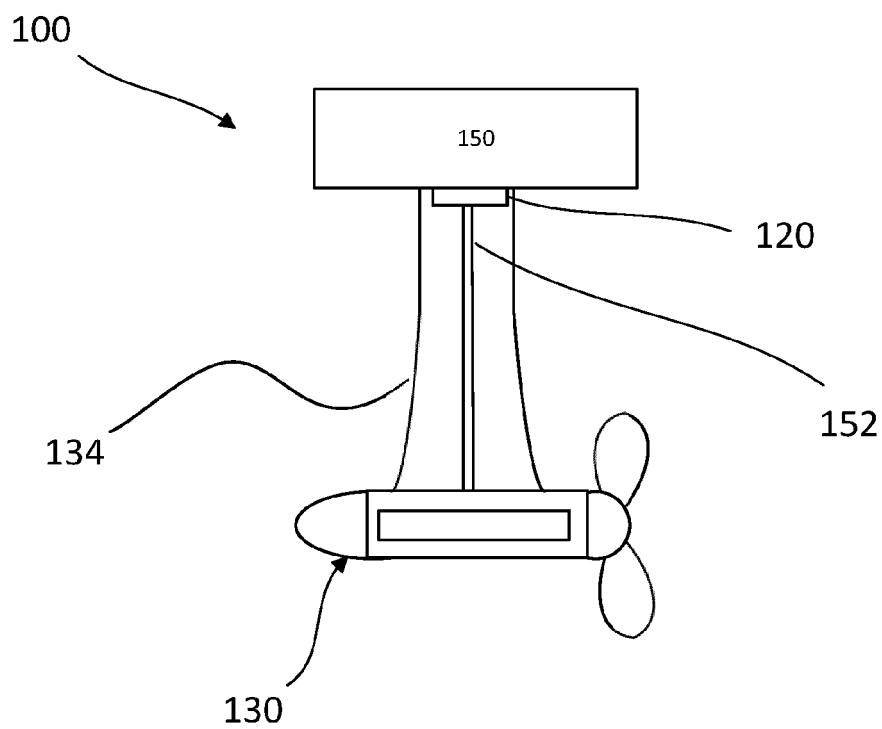


FIG. 3A

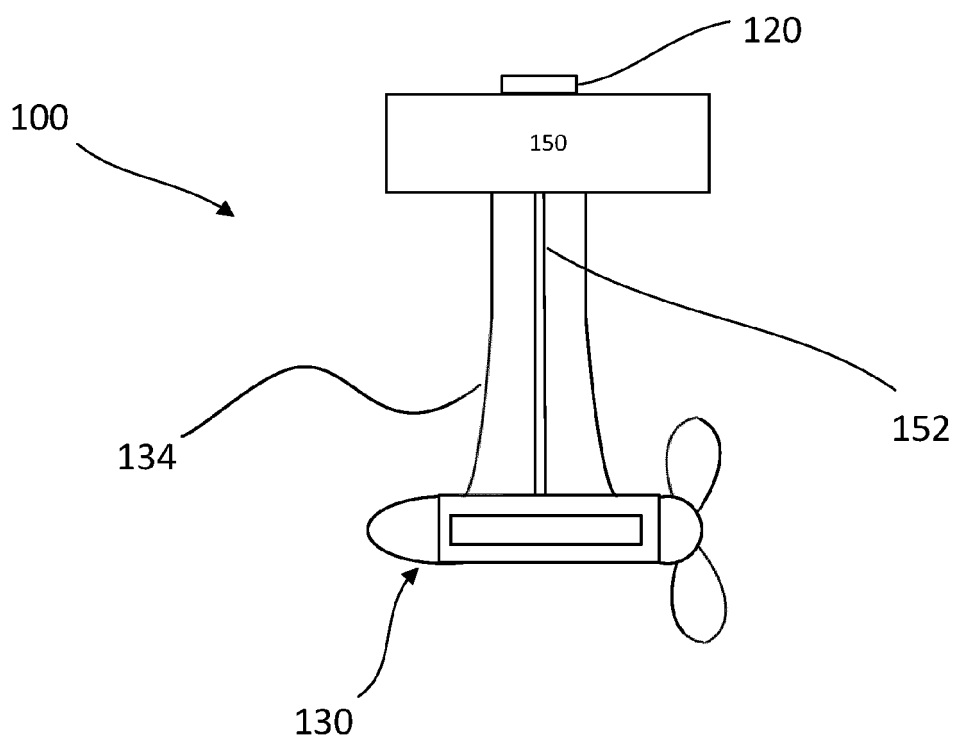


FIG. 3B

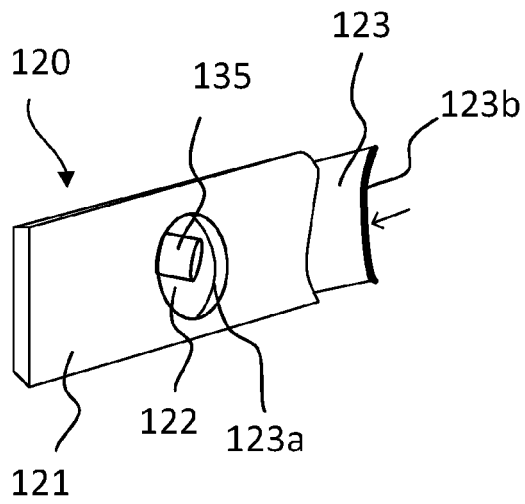


FIG. 4A

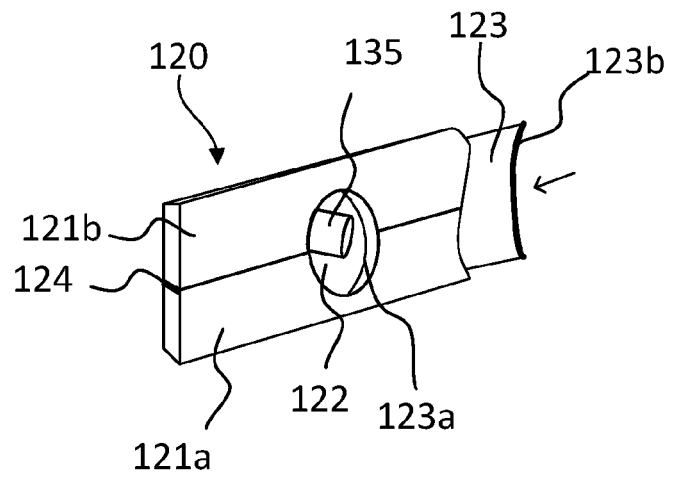


FIG. 4B

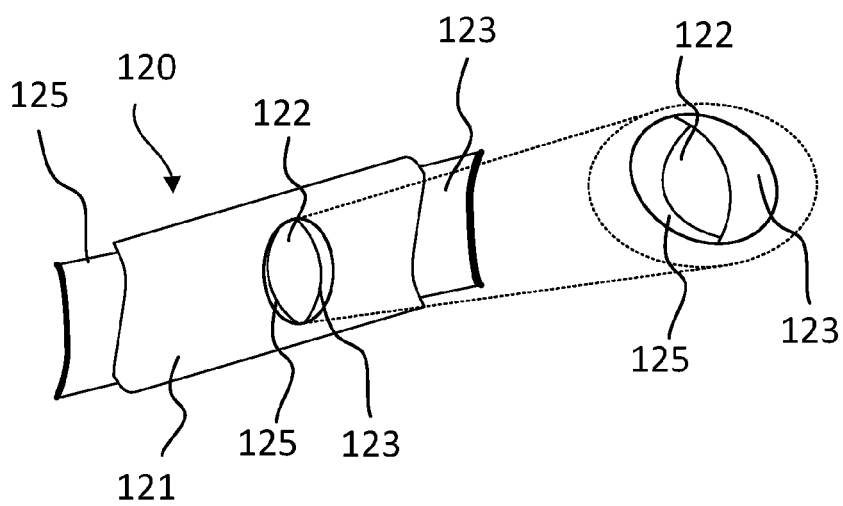


FIG. 4C

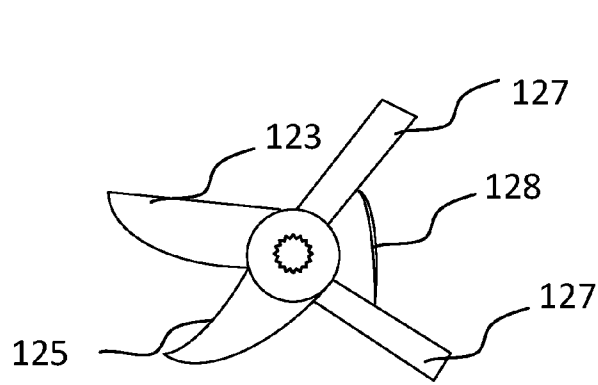


FIG. 4D

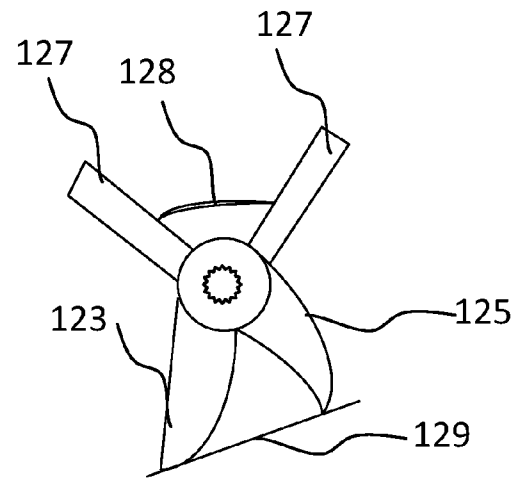


FIG. 4E

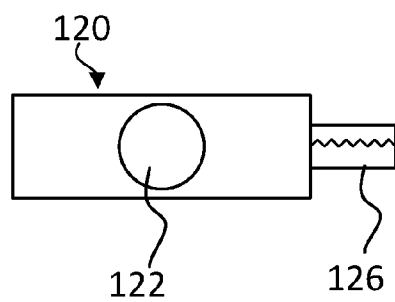


FIG. 5A

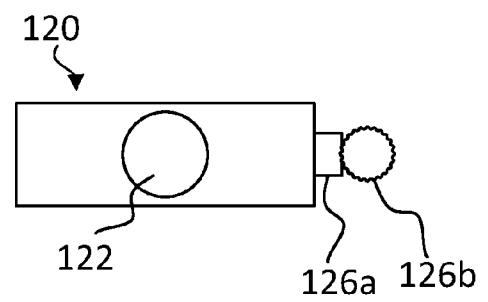


FIG. 5B

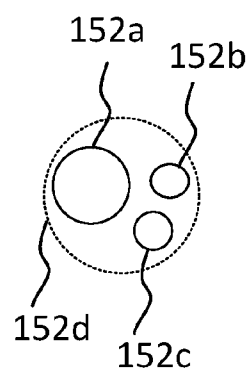


FIG. 6A

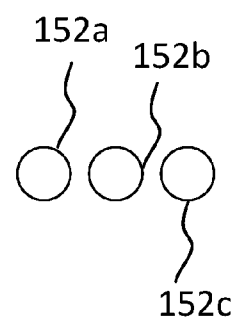


FIG. 6B



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 9990

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2021 154946 A (YAMAHA MOTOR CO LTD) 7 October 2021 (2021-10-07) * abstract; figures 1,2 * * column 7, line 24 - line 51 *	1-15	INV. B63B43/18 B63B43/20 B63H21/17
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A	US 8 944 865 B1 (KRABACHER MATTHEW S [US] ET AL) 3 February 2015 (2015-02-03) * abstract; figures *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			B63B B63H
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		28 May 2024	Balzer, Ralf
CATEGORY OF CITED DOCUMENTS			
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28-05-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82