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(54) **WATER PROPULSION APPARATUS**

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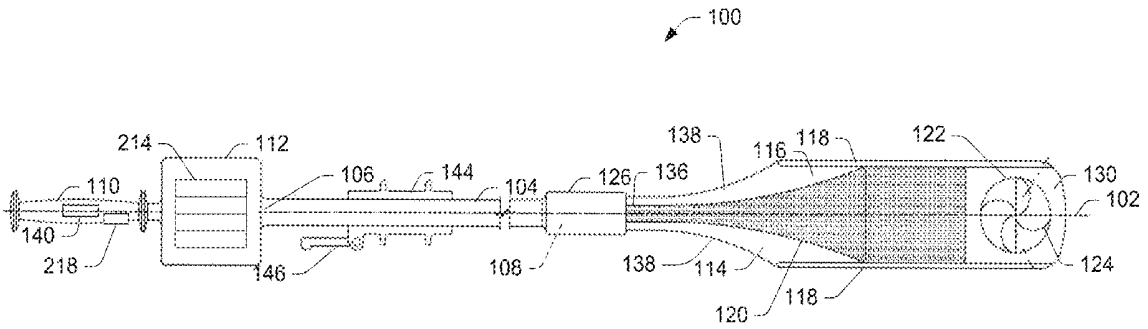
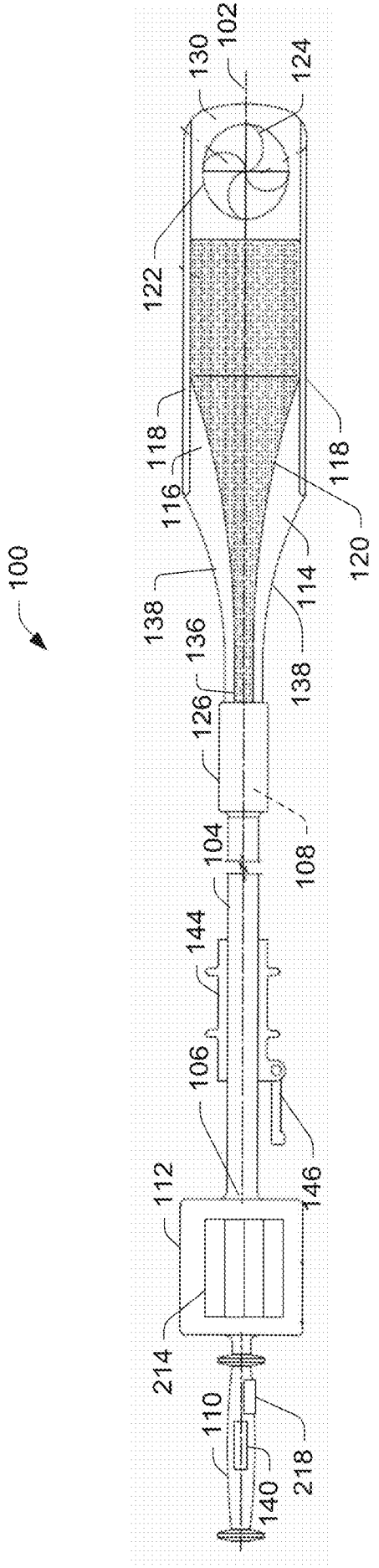
(57) **ABSTRACT**

The present disclosure relates to a water propulsion apparatus. In some examples, a water propulsion apparatus comprises a body extending from a proximal end to a distal end. A handle is provided on the proximal end. A blade is provided on the distal end and has an opening extending entirely through the blade. An impeller is positioned within the opening and is rotatable to provide automated thrust to the apparatus.




100
102
130
124
122
118
116
118
120
114
138
136
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126
104
108
144
106
112
146
214
110
218
140

FIG. 1A

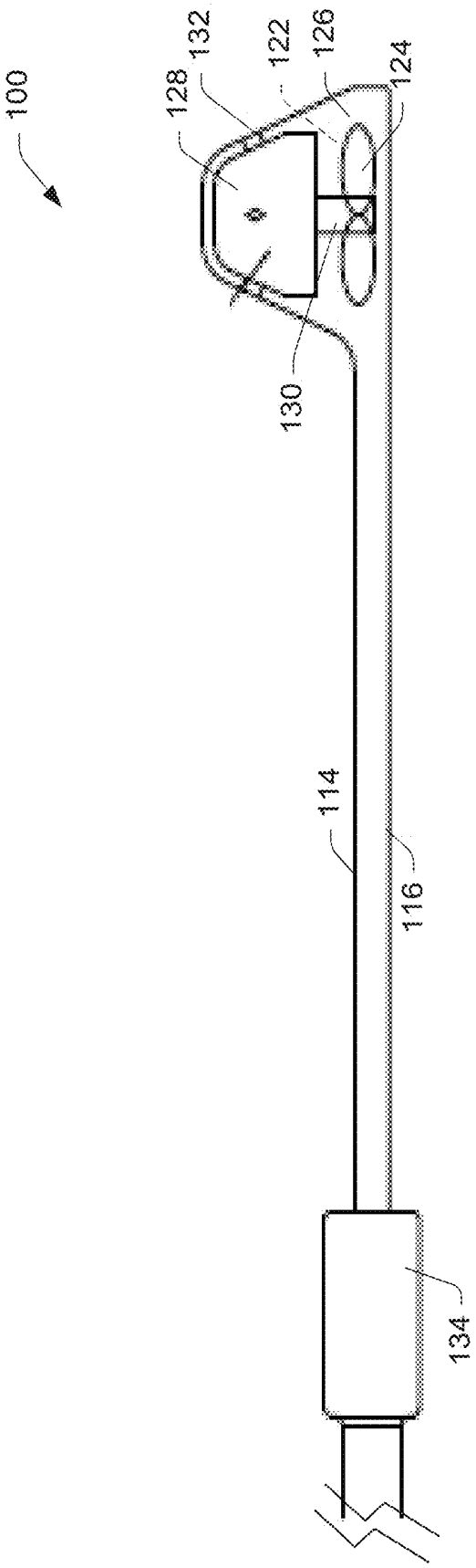

FIG. 1B

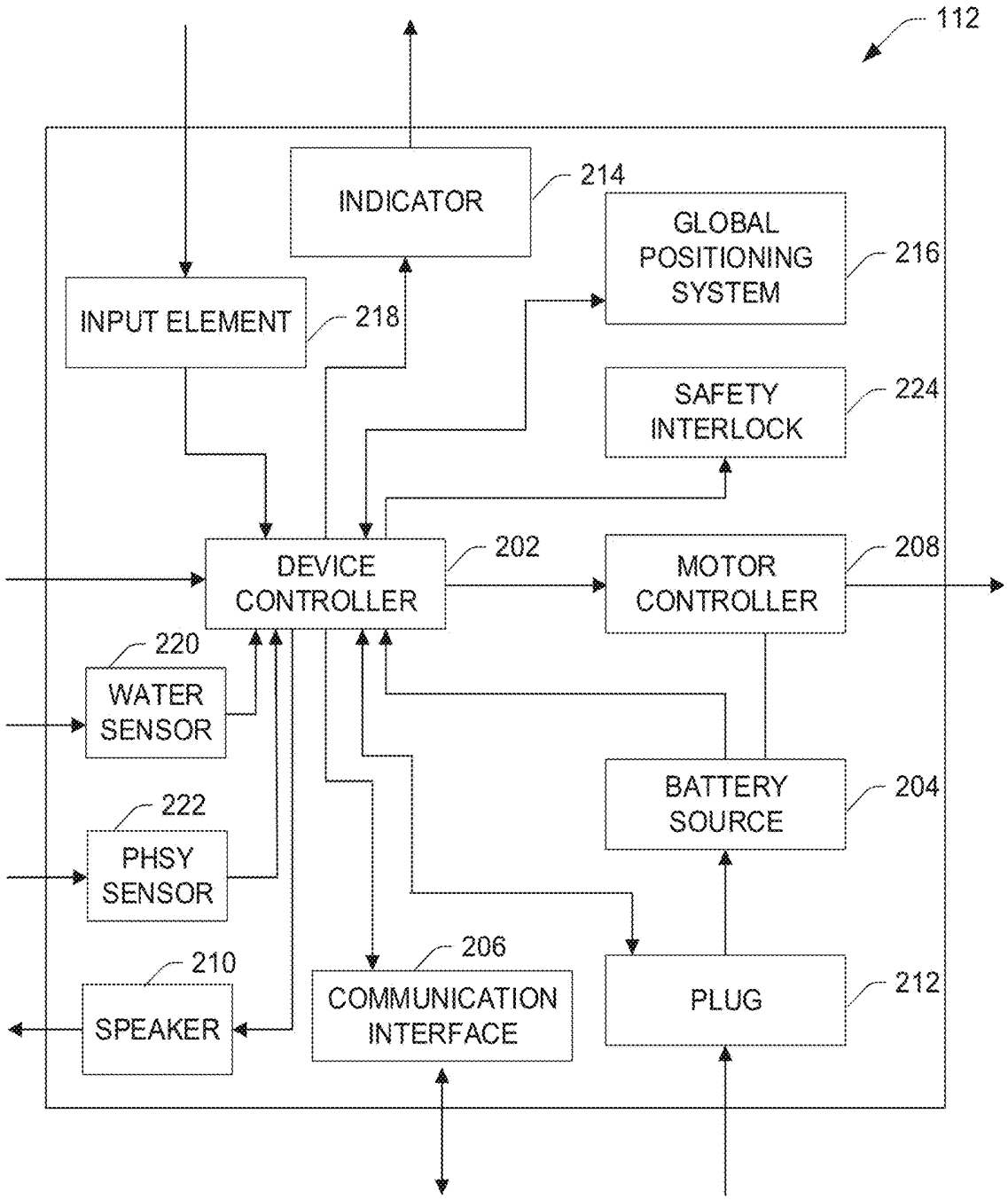
112
INDICATOR
214
GLOBAL POSITIONING SYSTEM
216
INPUT ELEMENT
218
SAFETY INTERLOCK
224
DEVICE CONTROLLER
202
MOTOR CONTROLLER
208
220
WATER SENSOR
BATTERY SOURCE
204
222
PHSY SENSOR
206
210
COMMUNICATION INTERFACE
PLUG
212
SPEAKER

FIG. 2

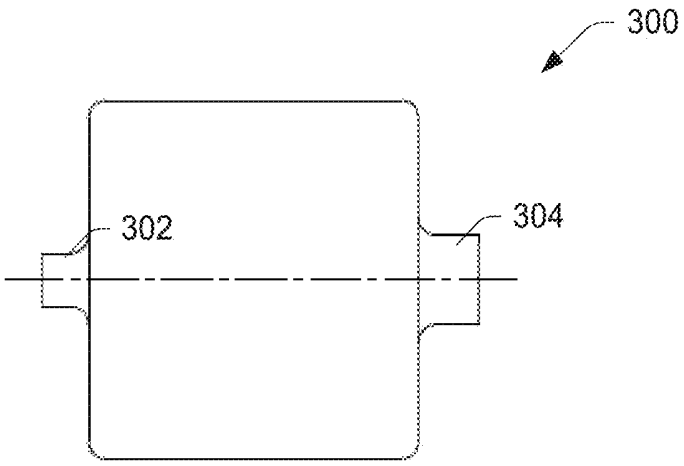

FIG. 3

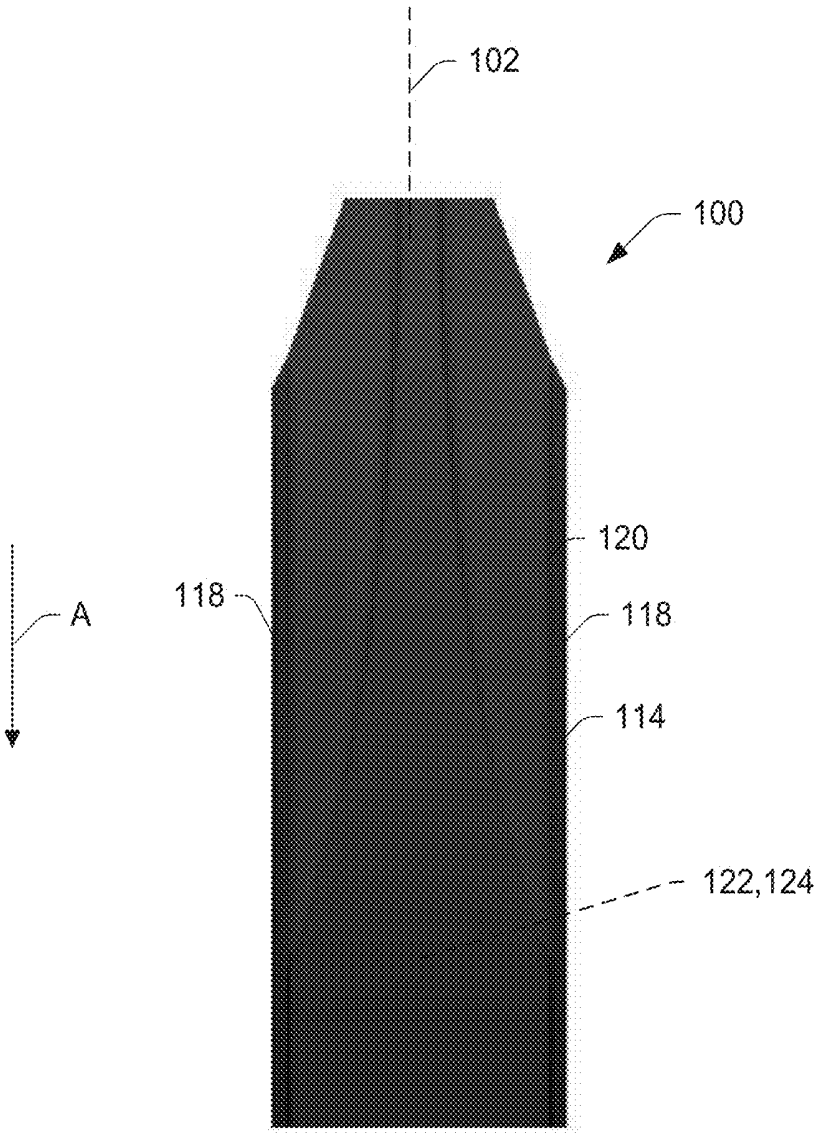

FIG. 4

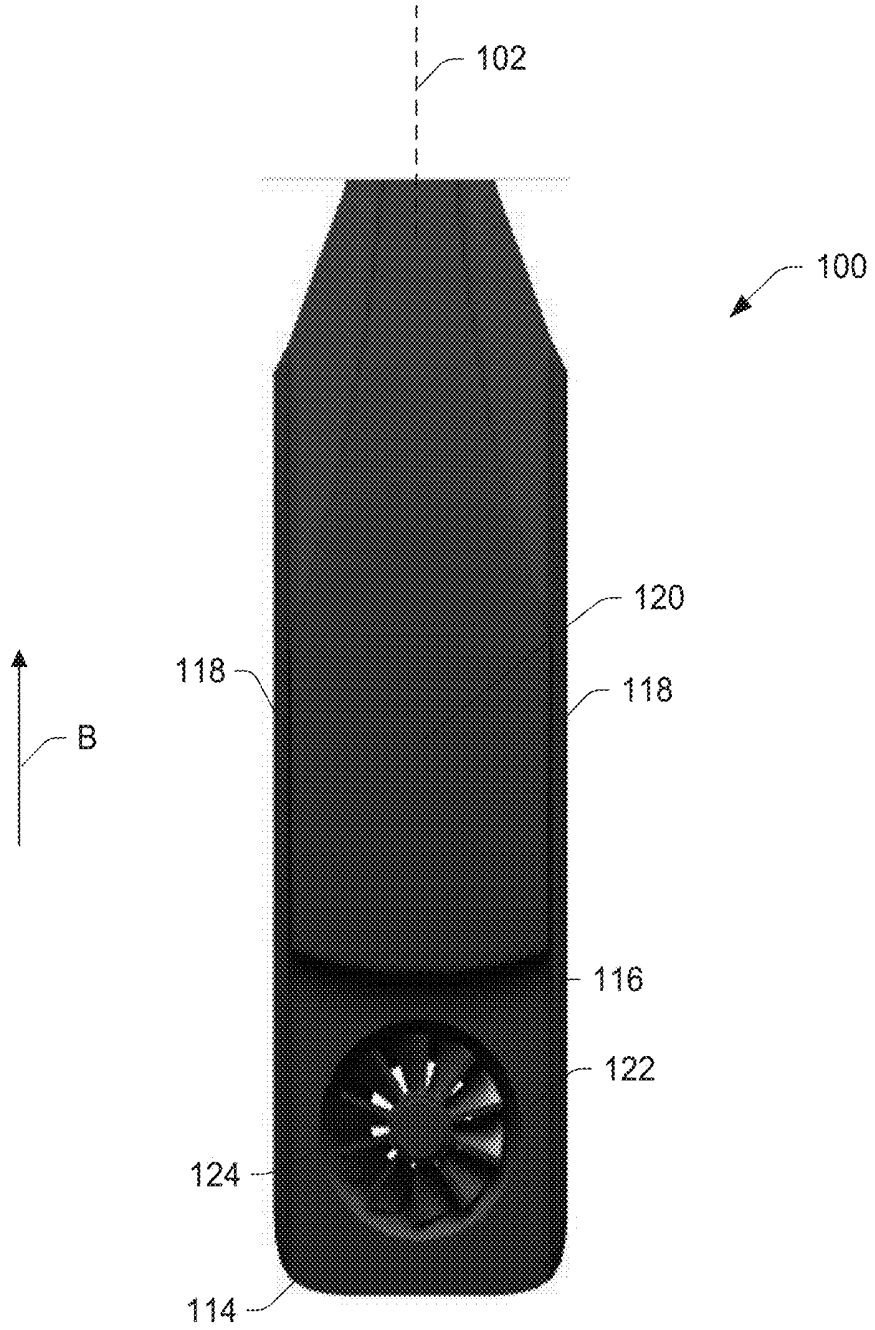

FIG. 5

WATER PROPULSION APPARATUS

CROSS-REFERENCE TO RELATED APPLICATION

[0001] This application claims the benefit of priority from U.S. Provisional Patent Application No. 62/709,753, filed 29 Jan. 2018, and entitled "SMART OAR," which is incorporated herein by reference in its entirety.

TECHNICAL FIELD

[0002] The present disclosure relates to water propulsion. More particularly, the present disclosure relates to a water propulsion apparatus.

BACKGROUND

[0003] Oars, paddles and like water propulsion devices usually include a shaft having an integral blade at one end thereof. When the device is moved through water, the device causes a reaction which propels a water vehicle (e.g., a ship, a boat, a kayak, etc.). At the end of each stroke or movement of the device, it is lifted out of the water, returned to its initial position and the propelling stroke is repeated.

SUMMARY

[0004] In an example, a water propulsion apparatus comprises a body extending from a proximal end to a distal end. A handle is provided on the proximal end. A blade is provided on the distal end and has an opening extending entirely through the blade. An impeller is positioned within the opening and is rotatable to provide automated thrust to the apparatus.

[0005] In another example, a water propulsion apparatus comprises a body extending from a proximal end to a distal end. A handle is provided on the proximal end. A blade is provided on the distal end and has an opening extending entirely through the blade. A motor is connected to the blade. A cover is connected to the body and movable relative to the blade from a closed condition covering the opening to an open condition spaced entirely from the opening in the blade. An impeller positioned within the opening and rotatably connected to the motor to provide automated thrust to the apparatus when the cover is in the open position.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1**A is a perspective view of an example water propulsion apparatus.

[0007] FIG. **1**B illustrates a side-view of a portion of the water propulsion apparatus of FIG. **1**A.

[0008] FIG. **2** illustrates an example control device of the water propulsion apparatus.

[0009] FIG. **3** illustrates an example housing for the control device of FIG. **2**.

[0010] FIG. **4** illustrates a cover of the water propulsion apparatus in a closed condition.

[0011] FIG. **5** illustrates the cover of the water propulsion apparatus in an open condition.

DETAILED DESCRIPTION

[0012] The present disclosure relates to water propulsion. More particularly, the present disclosure relates to a water propulsion apparatus.

[0013] The water propulsion apparatus can be employed to provide water-borne propulsion for a user or a water vehicle, either manually or in an automated manner. For example, the user can hold the water propulsion apparatus with two hands, some distance apart from each other, and pass a blade of the water propulsion apparatus through the water to manually generate thrust to move the water vehicle in a given direction. An impeller on the blade is covered by a sliding cover during manual thrust generation.

[0014] The impeller can be coupled directly to a shaft of the motor on the water propulsion apparatus (i.e., no gear reduction is required to couple the impeller to the motor). The cover can be slid away from the impeller to expose the impeller such that actuating the motor causes rotation of the impeller. This generates thrust in an automated manner to move the water vehicle or the user through the water in the given direction.

[0015] In some examples, the water propulsion apparatus can be substantially fabricated from carbon fiber such that the water propulsion is light weight, durable and can float on the water. To this end, the user can employ the water propulsion apparatus when not in the water vehicle to provide buoyancy. Accordingly, the water propulsion apparatus can function as a lifebuoy to propel the user through the water (e.g., to safety, another location, etc.). For example, during an emergency (e.g., after or during capsizing) the user can fall into the water. While in the water, the user can grasp the water propulsion apparatus and actuate the motor to generate thrust and move the user through the water to safety.

[0016] The water propulsion apparatus described herein can be utilized in various applications including nautical sports, navigation, water emergencies, recreational events, law enforcement applications, military applications (e.g., training), as a safety element (e.g., a floating device), reconnaissance applications (e.g., provide reconnaissance of distressed water vehicles), etc. Although the water propulsion apparatus is described herein in relation to an oar, the examples described herein should not be construed and/or limited to only oars, and can include paddles, or similar water propulsion devices.

[0017] FIGS. **1**A-**1**B illustrate an example water propulsion apparatus **100** for helping propel a user or a water vehicle (e.g., a boat, kayak raft, etc.) through water. The water propulsion apparatus **100** extends longitudinally along an axis **102** and includes a body **104**. The body **104** extends from a proximal end **106** to a distal end **108**. A handle **110** and a control device **112** are connected to the distal end **108**. In an example, the handle **110** is configured to float and can therefore be used by the user as a floating beacon.

[0018] A blade **114** is provided at the distal end **108** and includes a blade face **116**. Curved edges **118** extend from the blade face **116** towards one another and towards the axis **102** to define curved grooves for slidably receiving a cover **120**. While holding the handle **110** with one hand and the body **104** with the other hand, the user can draw the apparatus **100** through the water in any direction (e.g., from front to back or back to the front) to manually generate thrust to move the water vehicle in a given direction (e.g., in a forward direction or a reverse direction).

[0019] An opening **122** extends entirely through the blade **114** and receives an impeller **124**. More specifically, the opening **122** can extend from the blade face **116** of the blade **114** through a thickness of the blade **114** perpendicular to the

axis **102**. The depth of the opening **122** can be a function of the blade thickness. In some examples, the opening **122** can be constructed to gradually decrease in diameter in a direction extending through the blade **114** and away from the blade face **116**.

[0020] A motor housing **126** is formed integrally with the blade **114** or connected thereto. In either case, the motor housing **126** is aligned with the opening **122**. The motor housing **126** can include openings **132** (e.g., passageways) in fluid communication with the opening **122** to pass through the water drawn into the opening **122** by the impeller **124** in order to generate the thrust. A motor **128** can be secured to inner sidewalls of the motor housing **126** by a coupling mechanism (e.g., screws). The motor **128** includes a shaft **130** extending into the opening **122** and coupled directly to the impeller **124**. As such, the impeller **124** can be coupled directly to the shaft **130** without reduction gearing. In some examples, the motor **128** can correspond to a direct-current (DC) motor (e.g., a 48 V DC motor). As described herein, the motor **128** provides power to the impeller **124** to turn the impeller **124** and generate thrust for moving the water vehicle or the user across the water. The impeller **124** can be a multi-stage impeller (e.g., a two-stage impeller, three-stage impeller, etc.) and/or turbo jet impeller and can be constructed from a carbon fiber material. The multi-stage impeller can create a hydro jet propulsion to thrust the water vehicle or the user in a given direction.

[0021] The cover **120** has an open condition spaced from the opening **122** and a closed condition covering the opening. In other words, the cover **120** is movable along the axis **102** to selectively cover the opening **122**. The cover **120** is placed in the closed condition while the user is manually drawing the blade **114** through the water to generate thrust and to move the water vehicle in the given direction. The cover **120** is placed in the open condition when it is desirable to operate the impeller **124** to propel the water vehicle or the user through the water in an automated manner.

[0022] A bushing **134** extends over the body **104** and a flared or tapered end **136** of the blade **114** and is longitudinally movable relative thereto. The bushing **134** is secured to the cover **120** such that longitudinal movement of the bushing **134** causes the cover **120** to move relative to the blade **114** and, thus, move relative to the opening **122**. As a result, the user can move the bushing **134** towards the opening **122** until the cover **120** reaches the closed condition covering the opening **122**.

[0023] The user can likewise move the bushing **134** towards the handle **110** until the cover **120** is placed in the open condition spaced entirely from the opening **122**. Portions **138** of the blade **114** can be flared or tapered to form an abutment for the bushing **134** that provides tactile feedback to the user when the cover **120** has reached the closed condition. The bushing **134** can be formed from a resilient material that expands when the bushing **134** reaches the portions **138** of the blade **114** to form a friction fit that automatically locks the bushing **134** in place when the cover **120** reaches the closed condition.

[0024] The control device **112**, in response to receiving the signals from the touch sensor **142**, actuates the motor to turn the impeller **124** and generate thrust to propel the user or the water vehicle in an automated manner. This configuration helps to ensure that the impeller **124** is only driven when the user contacts the touch sensor **136** a period of time indicative of wishing to propel the user or the water vehicle in an automated manner (e.g., quickly touching and releasing the touch sensor will not cause the impeller **124** to rotate).

[0025] An example configuration of the control device **112** is shown in FIG. **2**. The control device **112** can include a device controller **202**, a battery source **204**, a communication interface **206**, a motor controller **208**, a speaker **210**, an electrical plug **212**, one or more indicators **214**, a global positioning system (GPS) **216**, an input element **218**, a water sensor **220**, one or more physiological sensors **222**, and a safety interlock **224**.

[0026] The battery source **204** can include one or more batteries (e.g., rechargeable batteries, such as lithium-ion batteries, or deep-cycle batteries). The battery source **204** can be removed from the apparatus **100** for external charging or fixed to the apparatus and charged via the electrical plug **212** when connected to an external power source (not shown). The controller **202** is connected to the battery source **204** and the electrical plug **212** and can cease the flow of electricity from the electrical plug to the battery source when the battery source is sufficiently charged.

[0027] The controller **202** is connected to the indicator **214** and actuates the same to indicate different conditions of the battery source **204** (e.g., the power level, when the power level is below a threshold amount, when the battery source needs charging, etc.). The indicator **214** can also indicate when the electrical plug **212** is connected to the external power source and/or when the battery source **204** is being charged by the external power source. To this end, the indicator **214** can include one or more light sources (e.g., one or more light emitting diodes (LEDs)) that indicate different conditions of the battery source **204** in different manners (e.g., by emitting different colors, flashing, etc.).

[0028] The indicator **214** can also act as an emergency beacon initiated automatically to transmit based on sensed conditions or by the user to output a beacon at a given radio-frequency (RF) that can be identified by an external source (e.g., RF receiver) or one or more lights can also be activated. In other words, the indicator **214** can generate and send RF signals, as well as visual indicators, to identify an emergency to persons other than the user. As such, if the user is in distress or in need of immediate rescue, the emergency beacon can be initiated so that appropriate personnel (e.g., rescue personnel) can assist the user.

[0029] In an example, the water sensor **220** sends a signal to the controller **202** in response to coming in contact with water or being submerged under water for a given period of time (e.g., five seconds). The controller **202**, in response to receiving the signal, can direct the indicator **214** to initiate the emergency beacon. As such, the controller **202** can be configured to cause the indicator **214** to emit or display the beacon based on the signal from the water sensor **220**.

[0030] The GPS **216** is connected to the controller **202** and is configured to communicate with one or more satellites (not shown) to determine location information for the water propulsion apparatus **100**. The controller **202** can be configured to cause the GPS **216** (e.g., periodically) to determine the location information for the water propulsion apparatus **100**. In response thereto, the controller **202** can cooperate with the indicator **214** to indicate (e.g., via different colored LEDs) to the user when the location has been obtained and/or when a satellite connection has been made.

[0031] The location data collected by the GPS **216** and received by the controller **202** can be stored in memory on board the control device **112** and/or sent to an external

device (not shown) via the communication interface **206**. The external device can include one or more of a laptop computer, a desktop computer, a tablet computer, a workstation, or the like. The communication interface **206** can be configured to communicate wirelessly (e.g., using Bluetooth, WiFi, etc.) and/or over a wired connection (e.g., a physical cable) with the external device.

[0032] In some examples, the communication interface **206** can include a universal serial bus for communicating data to the external device. The external device can be configured to execute a special-purpose application to receive and display the location information on a display of the external device. In some examples, the control device **112** can include a display (not shown) for displaying the location information.

[0033] The motor controller **208** is connected to the impeller **124** (FIG. **1**A) and the controller **202** for controlling the speed and/or direction of rotation of the impeller **124**. Rotation of the impeller **124** can be controlled in response to the user or the external device. With this in mind, the communication interface **206** can be employed to provide and/or receive data from the external device. The data can include impeller data and can be used by the controller **202** to control the motor controller **208** to regulate the speed and/or direction of the impeller **124**. The motor controller **208** can also be configured to provide a motor current to the motor **128** based on the charge stored at the battery source **204**. As such, the motor controller **208** can be configured to drive the motor **128** based on the charge stored at the battery source **204**.

[0034] In regards to the user, the input element **218** can include one or more buttons or combinations thereof (represented schematically in FIG. **1**A) that send signals to the controller **202** for controlling rotation of the impeller **124** in response to user interaction with the input element. The input element **218** can constitute a touch sensor (e.g., a capacitive or optical touch sensor) provided on the handle **110**. To this end, the input element **218** sends signals to the control device **112** when the user touches the input element **218** for greater than a predetermined amount of time. In other words, the input element **218** can be configured to distinguish grabs and touches. Touches can be defined as being less than a given amount of time (e.g., less than about 300 milliseconds (ms)), and grabs can be defined as at or more than the given amount of time (e.g., 300 ms or longer). This configuration helps to ensure the impeller **124** is only driven when the user contacts the input element **218** a period of time indicative of wishing to propel the user or the water vehicle in an automated manner (e.g., quickly touching and releasing the input device will not cause the impeller **124** to rotate).

[0035] In one example, the input element **218** can include a forward input, an off input, and/or a reverse input that each generate a signal indicative of a user input. In response to receiving a forward input signal, the controller **202** causes the impeller **124** to rotate in a clockwise direction to propel the water vehicle or the user in the water in a first given direction (e.g., a forward direction). In response to receiving a reverse input signal, the controller **202** causes the impeller **124** to rotate in a counter-clockwise direction to propel the water vehicle or the user in the water in another given direction (e.g., a reverse direction). In response to receiving an off input signal, the controller **202** stops rotation of the impeller **124** to thereby cease propulsion of the water vehicle or user in any particular direction. The controller **202** can be configured to generate an audible signal indicative of the input signal received and actuate the speaker **210** to emit the audible signal to the user.

[0036] The speed of the impeller **124** can be controlled by the user via a potentiometer. The potentiometer can corresponding to an input element (e.g., the input element **218**)). The speed of the impeller **124** can be increased by turning the potentiometer in a given direction (e.g., clock-wise direction), while turning the potentiometer in another direction (e.g., counter clock-wise direction) decreases the speed of the impeller **124**.

[0037] The one or more physiological sensors **222** can be connected to the user (e.g., via leads) and/or integrated into the handle **110** for monitoring a physical condition of the user while the user is utilizing (e.g., gripping) the water propulsion apparatus **100**. The physiological sensors **222** can include an electrocardiogram (ECG or EKG) sensor, a blood pressure sensor, a body temperature sensor, etc. As such, physiological conditions of the user can be monitored while the user is utilizing the water propulsion apparatus **100**.

[0038] The controller **202** can be configured to communicate the physiological condition data to the external device via the communication interface **206**. The external device can be configured to display on the display the physiological condition data. In an example, the controller **202** can be configured to evaluate the physiological condition data relative to baseline physiological condition data (e.g., data for a healthy user or a group of users) stored in memory to determine the user's physical condition. In response to determining that the user's condition has deviated from the baseline physiological condition data, the controller **202** can be configured to cause the indicator **214** to emit an indication for the user (e.g., a blinking light). Additionally, or alternatively, the controller **202** can be configured to cause the emergency beacon to emit the beacon at the given RF in response to determining that the user's condition has deviated from the baseline physiological condition data.

[0039] Referring to FIG. **1**A, the handle **110** can include an emergency release pressure sensor **140** connected to the handle or integrally formed therewith. The emergency release pressure sensor **140** can be actuated by the user (e.g., by pressing against the sensor **140**) to cut power to the motor **128**. Additionally, or alternatively, the emergency release pressure sensor **140** can be actuated by the user to cause one or more indicators (e.g., the indicator **214**) to emit one or more lights (e.g., signal lights, such as distress lights).

[0040] Referring back to FIG. **1**A, the body **104** can be formed from a series of telescoping tubes (not shown) that allow the length of the apparatus **100** to be varied along the axis **102**. A locking mechanism **144** is provided on the body **104** and includes a lock **146** (e.g., a pivoting handle). The lock **146** can be disengaged from the body **104** by the user to allow the length of the apparatus **100** to be adjusted by telescoping action. The lock **146** can be engaged with the body **104** by the user to fix the length of the apparatus **100**. For example, the lock **146**, when engaged, can create a force perpendicular to the axis **102** that prevents telescoping movement of the apparatus **100**. In one example, the locking mechanism **144** is a u-joint locking mechanism and the lock **146** is a lock lever. Portions of the water propulsion apparatus **100**, including the handle **110**, the body **104**, the blade **114**, and the locking mechanism **144** can be hollow and/or

constructed from a carbon fiber material. The safety interlock **224** can be coupled to the locking mechanism **144** and can be configured to cooperate with the controller to prevent the impeller **124** from being rotate so long as the cover **120** is in the closed position covering the impeller **124**.

[0041] FIG. **3** illustrates an example of a control device housing **300** for the control device **112**. A tubular, first hollow body portion **302** of the control device housing **300** receives the handle **110**. A tubular, second hollow body portion **304** receives the proximal end **106** of the body **104**. The housing **300** can be waterproof and constructed from a lightweight, durable material, (e.g., carbon fiber). One or more elements of the control device **112** are sealed within the housing **300** to protect the elements from the surrounding environment. As such, the housing **300** can provide an air-tight seal around one or more elements of the control device **112**. Certain features of the control device **112**, however, such as the water sensor **220** can protrude from or be exposed through the housing **300** (not shown in FIG. **3**) for water sensing, as described herein.

[0042] Referring to FIG. **4**, for manual operation of the water propulsion apparatus **100**, the cover **120** is moved in the direction A along the axis **102** to the closed condition covering the opening **122** and thereby preventing the impeller **124** from providing thrust. Referring to FIG. **5**, when automated thrust is needed/desired, the cover **120** is moved in the direction B to the open condition spaced entirely from the opening **122** and impeller **124**. This allows the impeller **124** to be controlled by the user to provide an automated thrust to the water propulsion apparatus **100**. To this end, when the cover **120** is in the open condition, operating the input element **218** provides the corresponding signal (e.g., the forward signal, the reverse signal, etc.) to the controller **202** which, in turn, directs the motor controller **208** to operate the impeller **124**. Accordingly, while the cover **120** is in the open position, the impeller **124** can generate thrust to move the water vehicle or the user across the water in a desired manner. The controller **202** can prevent rotation of the impeller **124** when the cover **120** is in the closed position.

[0043] In some examples, the water propulsion apparatus **100** can be used in emergency applications. For example, while moving a water vehicle across water, the water vehicle may be intentionally or unintentionally overturned, or may experience dangerous waters and/or weather conditions that may result in the water vehicle being overturned, thereby forcing the user into the water. In response, the user can operate the water propulsion apparatus **100** to help reach a safer location. For example, the user, while in the water, can operate the input element **218** to cause the impeller **124** to generate thrust while the user holds the water propulsion apparatus **100**. This propels the user through the water to help the user get to safety. Accordingly, the water propulsion apparatus **100** can allow the user to get to safety quickly and effectively.

[0044] In some examples, the water propulsion apparatus **100** can be used to provide thrust while the user is within the water vehicle. For example, the user can partially position the blade **114** in the water while the cover **120** is in the open condition such that the opening **122** and therefore the impeller **124** are submerged under water. The user can then operate the input element **218** to cause rotation of the impeller **124** to generate thrust by drawing water with the rotating impeller **124** into the opening **122** and discharging the water out of the openings **132** in the motor housing **126**. The openings **132** of the motor housing **126** can therefore be configured to direct the water in a desired direction to provide thrust. The rotation of the impeller **124** and orientation of the blade **114** in the water relative to the water vehicle will dictate the direction the thrust is imparted and therefore dictate the direction the water vehicle moves in response thereto.

[0045] Accordingly, the water propulsion apparatus **100** can create thrust for moving the water vehicle in an automated manner without requiring the user to manually generate the thrust to move the water vehicle across the water. The water propulsion apparatus **100** can be used by water vehicle operators that have limited or no knowledge of capsize processes (e.g., responding and/or recovering from a partial or complete capsize). In some examples, the water propulsion apparatus **100** can permit the user to conserve energy in emergency situations and not expend a substantial amount of physical energy in implementing capsize procedures. For instance, if the water vehicle is overturned, the user can utilize the water propulsion apparatus **100** to propel the user to an intended location (e.g., a safe location, land, another boat, etc.) without exerting substantial amount of physical energy to implement capsize procedures.

[0046] It will be appreciated, however, that the water propulsion apparatus **100** is configured to allow the user to manually provide thrust to the water vehicle in a conventional manner by paddling, which is done with the cover **120** in the closed position.

[0047] What have been described above are examples. It is, of course, not possible to describe every conceivable combination of components or methodologies, but one of ordinary skill in the art will recognize that many further combinations and permutations are possible. Accordingly, the disclosure is intended to embrace all such alterations, modifications, and variations that fall within the scope of this application, including the appended claims. As used herein, the term "includes" means includes but not limited to, the term "including" means including but not limited to. The term "based on" means based at least in part on. Additionally, where the disclosure or claims recite "a," "an," "a first," or "another" element, or the equivalent thereof, it should be interpreted to include one or more than one such element, neither requiring nor excluding two or more such elements.

What is claimed is:

1. A water propulsion apparatus comprising:

a body extending from a proximal end to a distal end;

a handle provided on the proximal end;

a blade provided on the distal end and having an opening extending entirely through the blade; and

an impeller positioned within the opening and being rotatable to provide automated thrust to the apparatus.

2. The water propulsion apparatus of claim **1** further comprising a cover connected to the body and movable relative to the blade from a closed condition covering the opening to an open condition spaced entirely from the opening in the blade

3. The water propulsion apparatus of claim **2**, further comprising a bushing coupled to the cover and configured to move the cover longitudinally from the open condition to the closed condition relative to the blade.

4. The water propulsion apparatus of claim 2, wherein the blade further comprises curved edges extending inwardly toward one another to define grooves for slidably receiving the cover.

5. The water propulsion apparatus of claim 1, wherein the impeller is a multi-stage impeller.

6. The water propulsion apparatus of claim 2, wherein the blade and the impeller are constructed from a carbon fiber material.

7. The water propulsion apparatus of claim 2, further comprising a motor coupled to the blade, wherein the impeller is coupled directly to a shaft of the motor without a gear reduction mechanism.

8. The water propulsion apparatus of claim 1, wherein the opening gradually decreases in diameter through the blade.

9. The water propulsion apparatus of claim 1, further comprising:

a motor for driving the impeller; and

and an emergency release pressure sensor provided on the handle and configured to cut power to the motor to cease providing the automated thrust to the apparatus.

10. The water propulsion apparatus of claim 1, further comprising a control device connected to the body and being configured to control at least one of a speed and a rotational direction of the impeller.

11. The water propulsion apparatus of claim 10, further comprising a touch sensor configured to provide a signal indicative of user touch of the handle, wherein the control device controls at least one of the speed and the rotational direction of the impeller based on the signal.

12. The water propulsion apparatus of claim 10, further comprising:

a water sensor configured to provide a signal when the apparatus comes into contact with the water or is submerged under water for a given period of time; and

an indicator configured to emit an indication based on the signal.

13. The water propulsion apparatus of claim 12, wherein the control device further comprises:

a global position system (GPS) configured to determine location information for the apparatus; and

a GPS indicator configured to emit an indication in response to determining the location information.

14. The water propulsion apparatus of claim 10, further comprising one or more physiological sensors configured to monitor physiological conditions of a user of the apparatus, wherein the one or more physiological sensors comprises one of an electrocardiogram sensor, a blood pressure sensor, and a body temperature sensor.

15. The water propulsion apparatus of claim 1, further comprising a control device connected to the body, the control device comprising a controller and an input element, wherein the input element is configured to generate an input signal, the controller being configured to control one of a rotation and speed of the impeller based on the input signal.

16. A water propulsion apparatus comprising:

a body extending from a proximal end to a distal end;

a handle provided on the proximal end;

a blade provided on the distal end and having an opening extending entirely through the blade;

a motor connected to the blade;

a cover connected to the body and movable relative to the blade from a closed condition covering the opening to an open condition spaced entirely from the opening in the blade;

an impeller positioned within the opening and rotatably connected to the motor to provide automated thrust to the apparatus when the cover is in the open position.

17. The water propulsion apparatus of claim 16, wherein the impeller is a multi-stage impeller.

18. The water propulsion apparatus of claim 17, wherein the impeller is coupled directly to the shaft without a gear reduction mechanism.

19. The water propulsion apparatus of claim 18, further comprising a bushel coupled to the cover and configured to move the cover longitudinally from the open condition to the closed condition relative to the blade.

20. The water propulsion apparatus of claim 19, wherein the blade further comprises curved edges extending inwardly toward one another to define grooves for slidably receiving the cover.

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摘要(译)

本发明涉及一种水推进装置。在一些示例中，水推进装置包括从近端延伸到远端的主体。手柄设置在近端上。刀片设置在远端上并具有完全穿过刀片延伸的开口。叶轮定位在开口内并可旋转以向设备提供自动推力。