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Broughton et al.

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(54) **WATERCRAFT WITH AN ELECTRIC MOTOR**

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B63B 1/14 (2006.01)

(52) **U.S. Cl.**
CPC ***B63H 21/17*** (2013.01); ***B63B 1/14*** (2013.01)

(58) **Field of Classification Search**
CPC B63H 21/17; B63H 1/14; B63B 1/14
See application file for complete search history.

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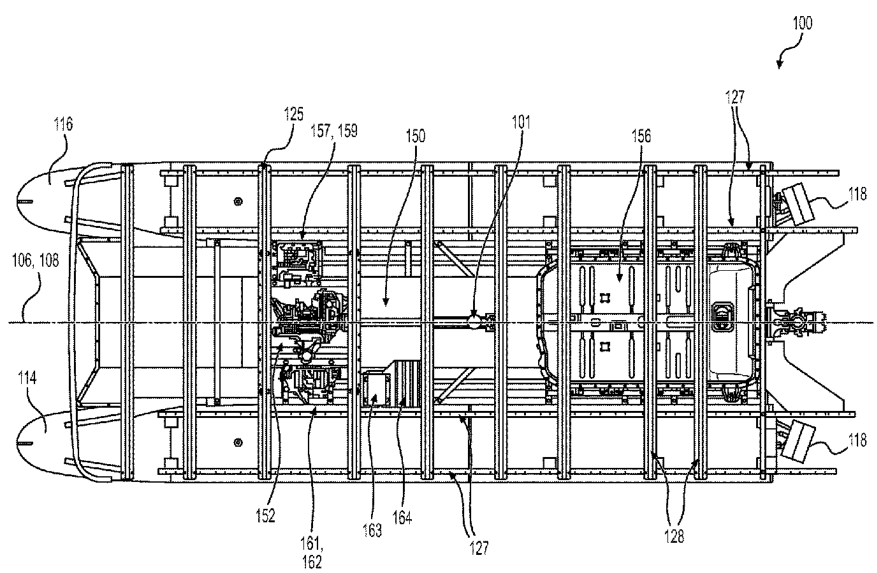
(57) **ABSTRACT**

A watercraft including a hull including a bottom surface, a channel being defined by the bottom surface; a deck disposed above the hull; a battery disposed in a rear portion of the watercraft below the deck; an electric motor disposed in a forward portion of the watercraft, the electric motor being disposed above the bottom surface of the hull and below the deck, the electric motor being electrically connected to the battery; a propulsion shaft operatively connected to the electric motor at a front end of the propulsion shaft, the propulsion shaft extending downward and rearward from the electric motor, the propulsion shafting passing through the bottom surface of the hull and extending into the channel; a propeller connected to a rear end portion of the propulsion shaft; and a rudder pivotally connected to at least one of the hull and the deck.

21 Claims, 12 Drawing Sheets



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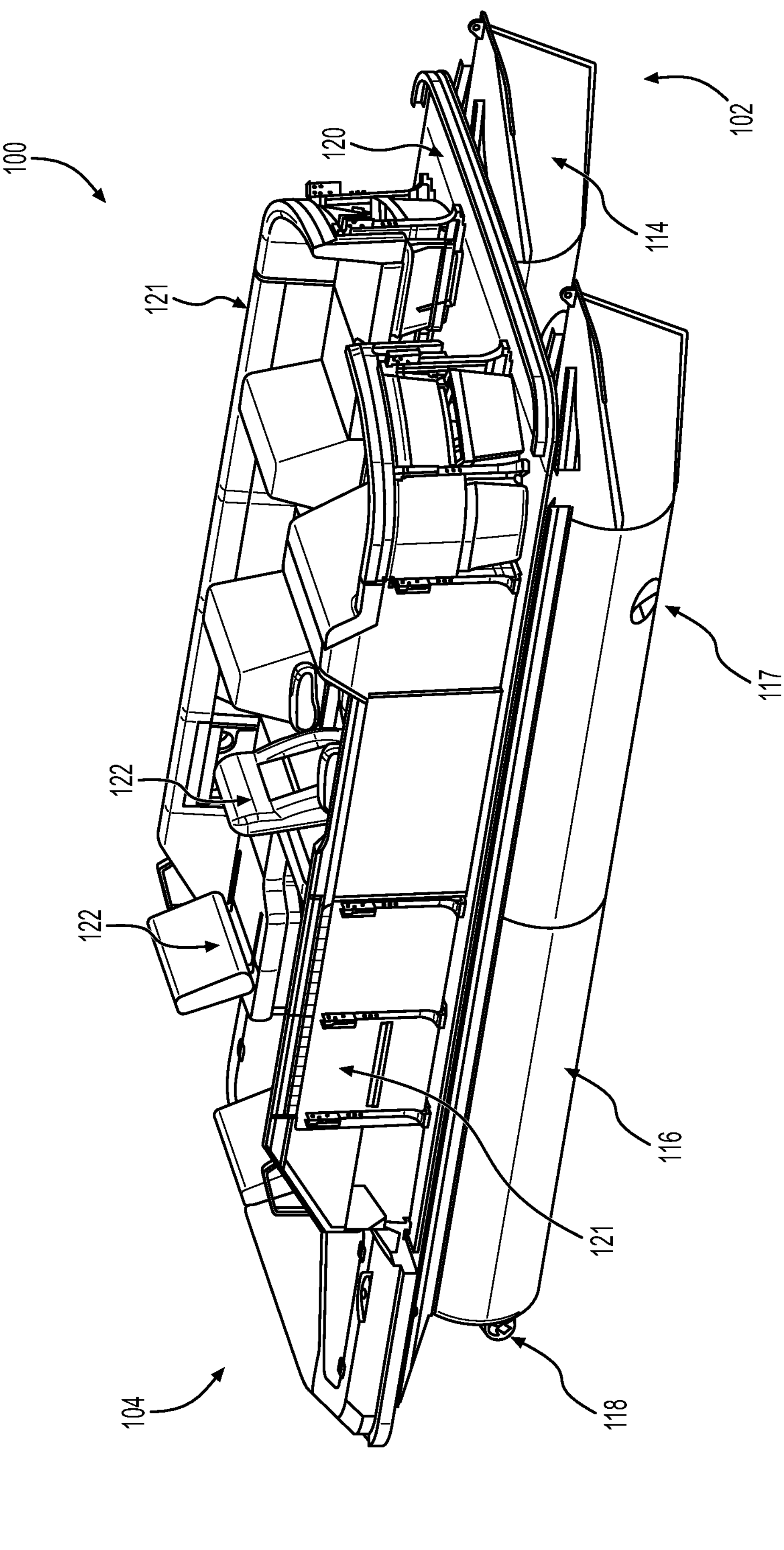

FIG. 1

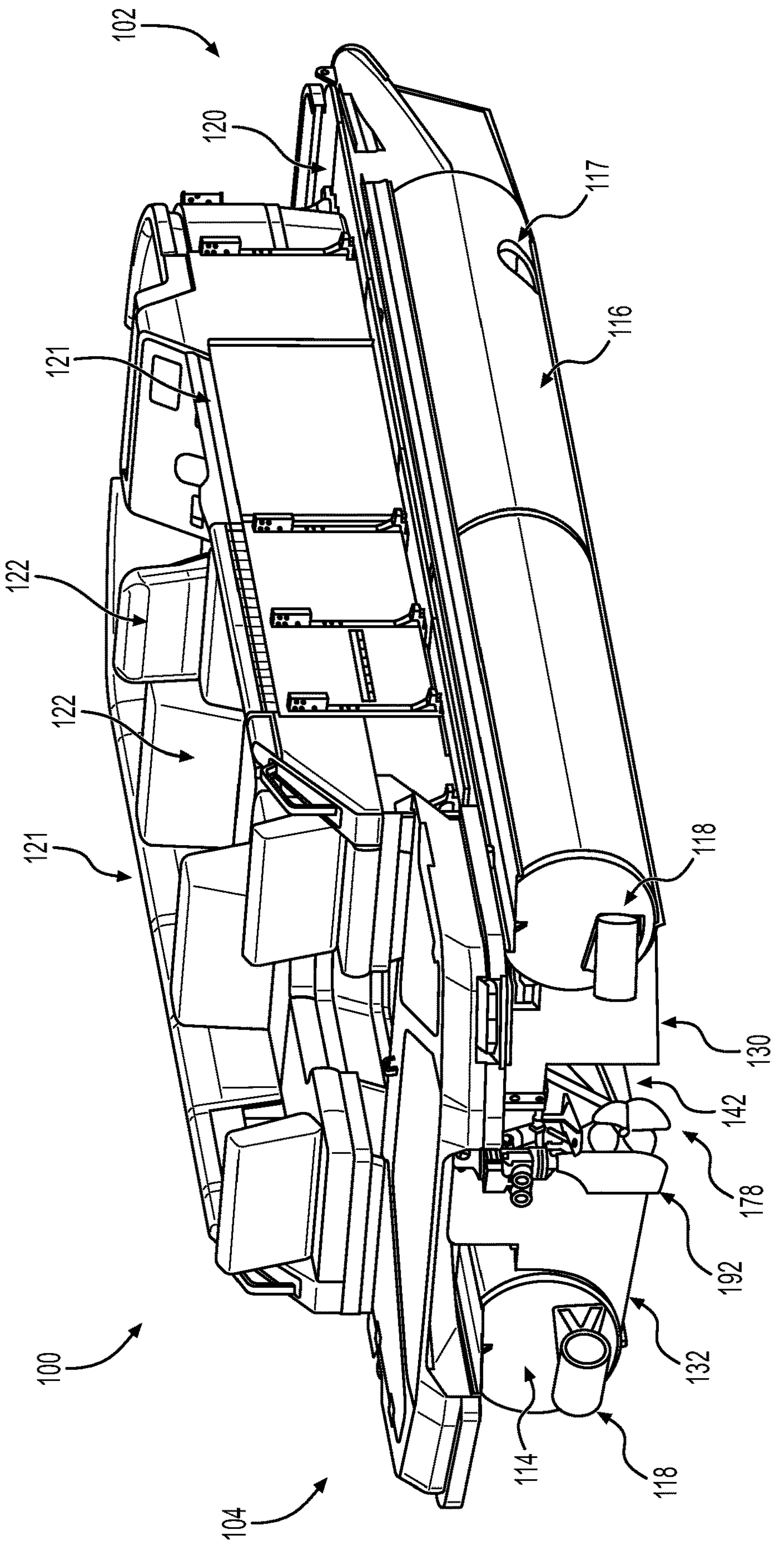
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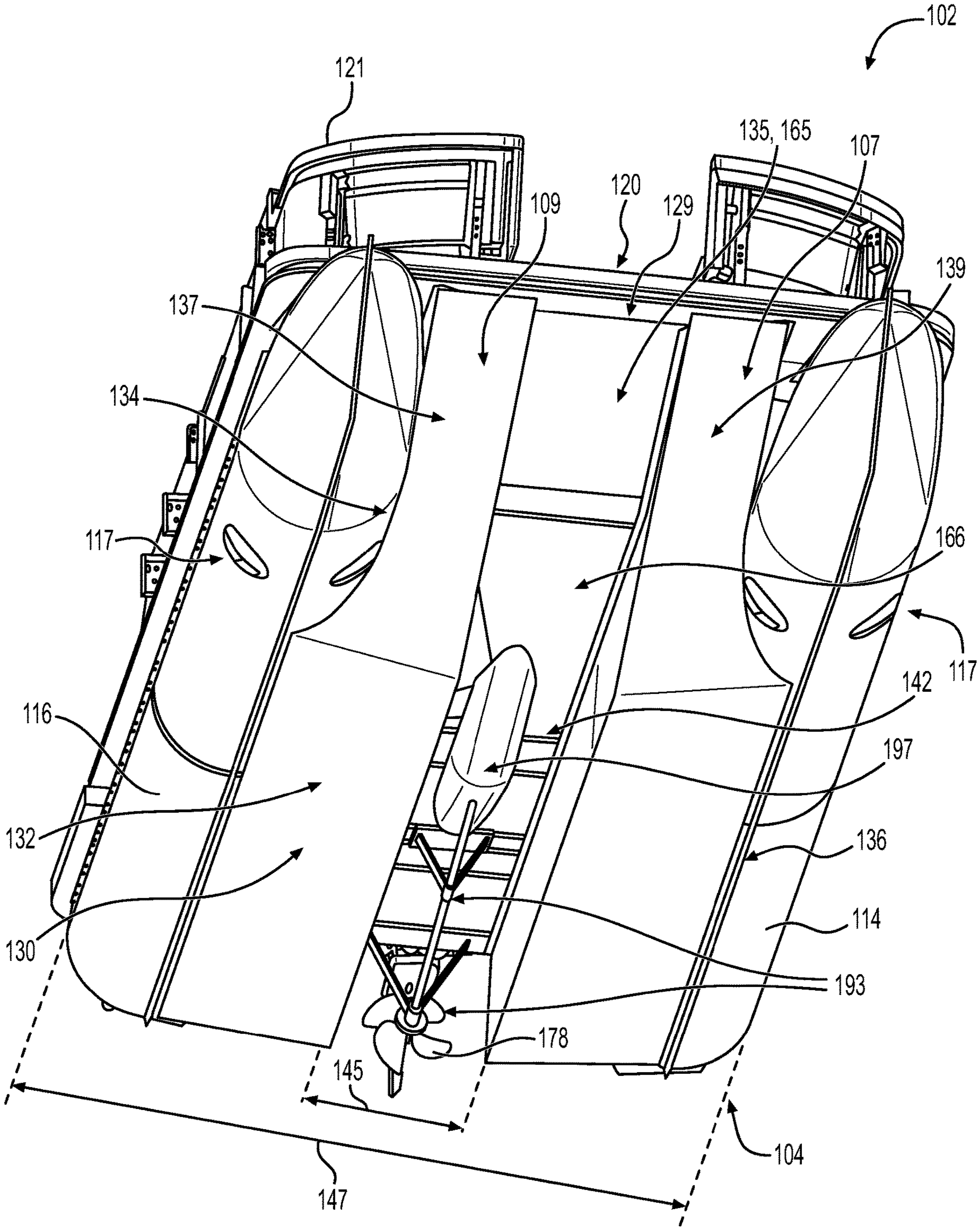
FIG. 2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135, 165
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145
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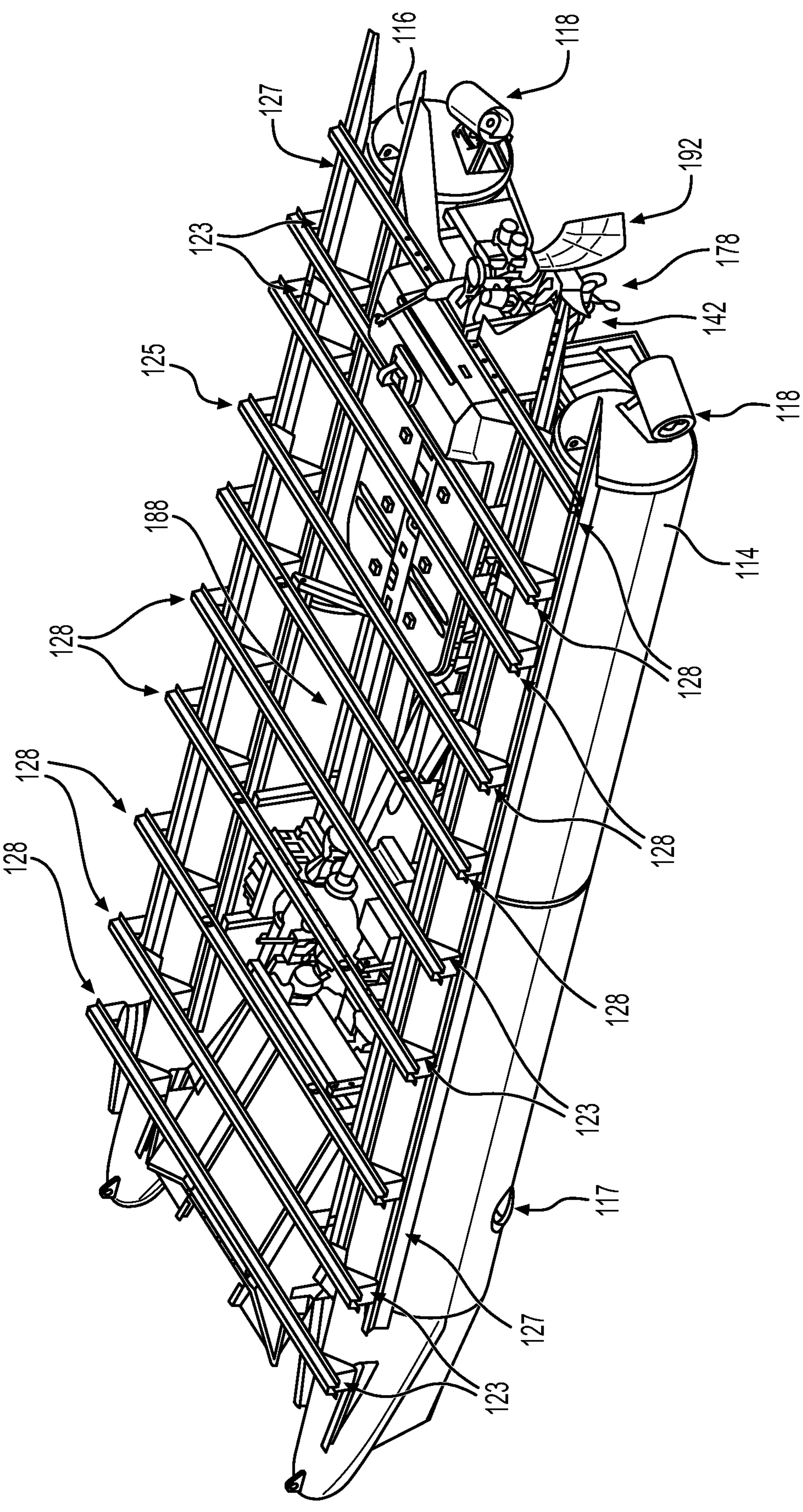
147

FIG. 3


116
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127
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FIG. 4

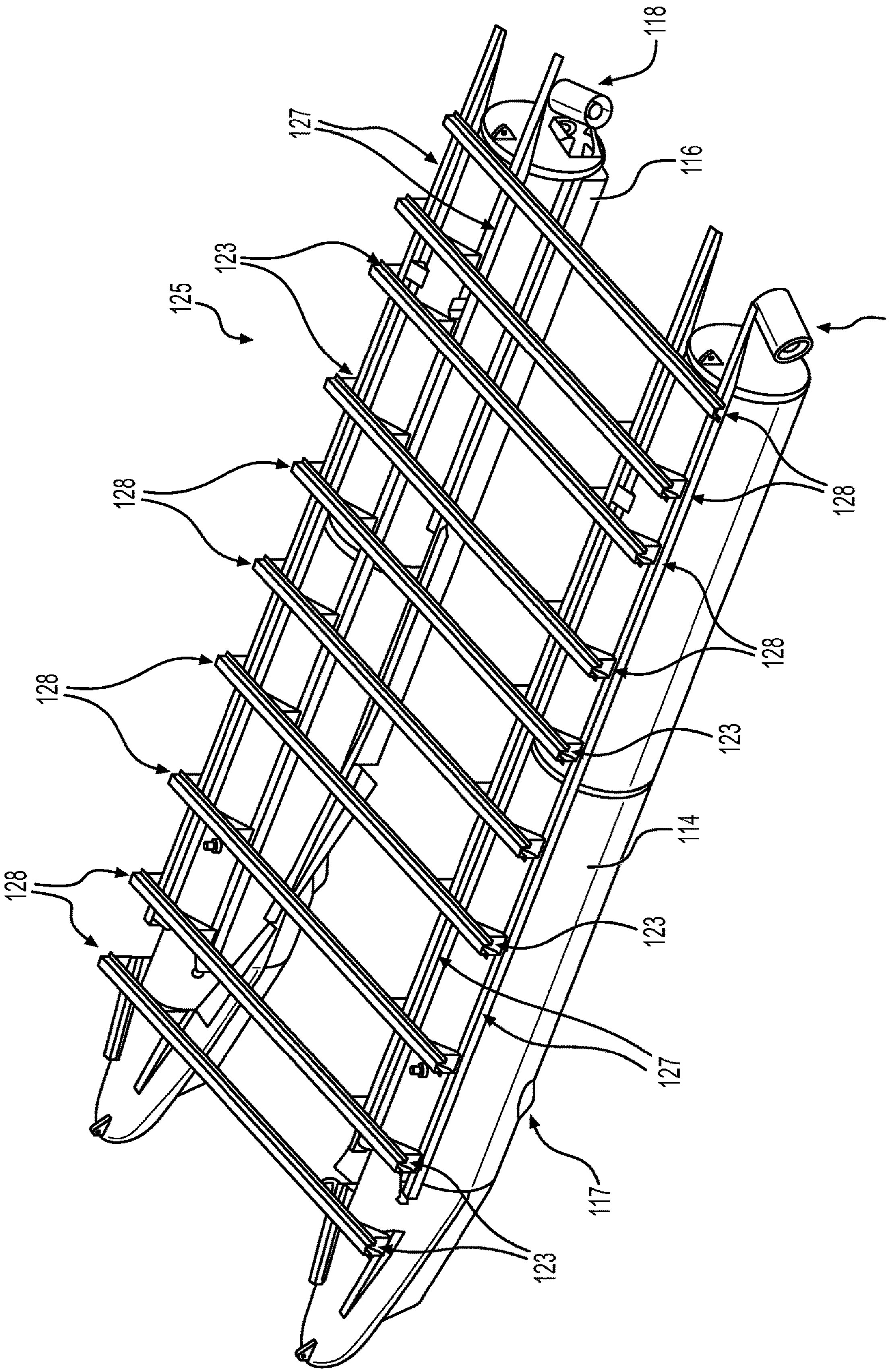
118
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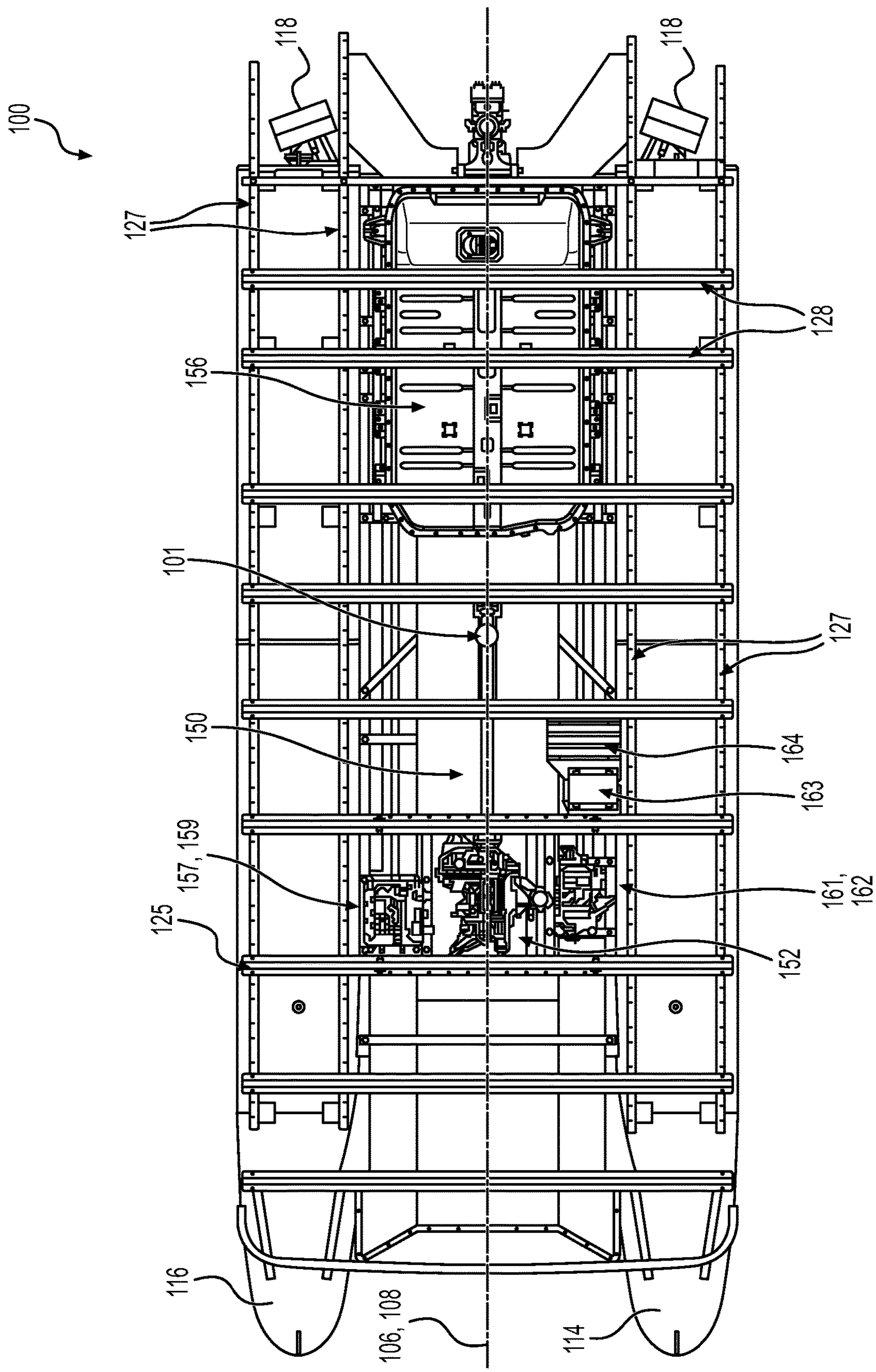
FIG. 5


100
118
118
127
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156
101
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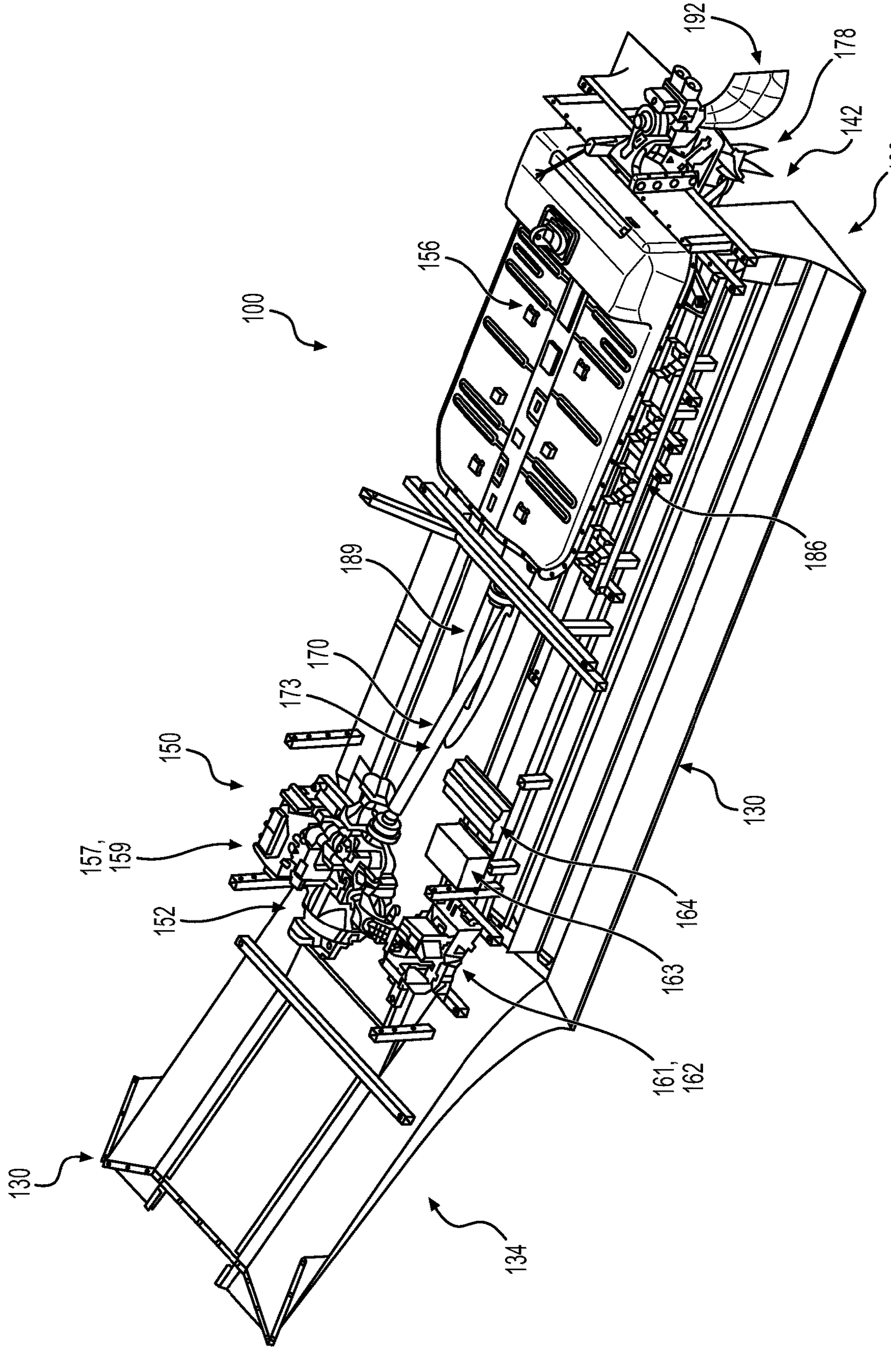
150
164
163
157, 159
161, 162
125
152
116
106, 108
114

FIG. 6


100
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142
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150
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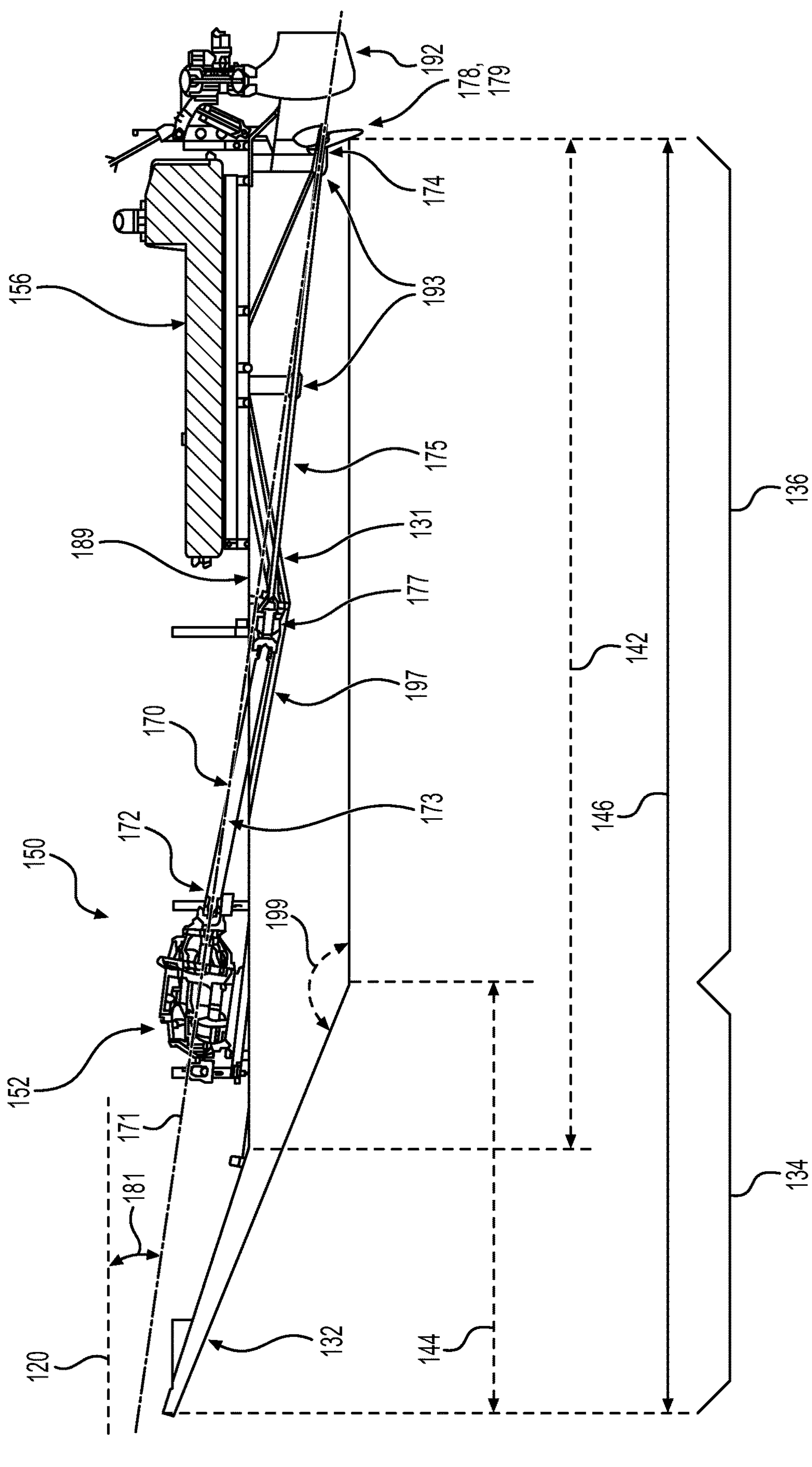
161, 162
130
130
134

FIG. 7


192
178,
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144
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134

FIG. 8

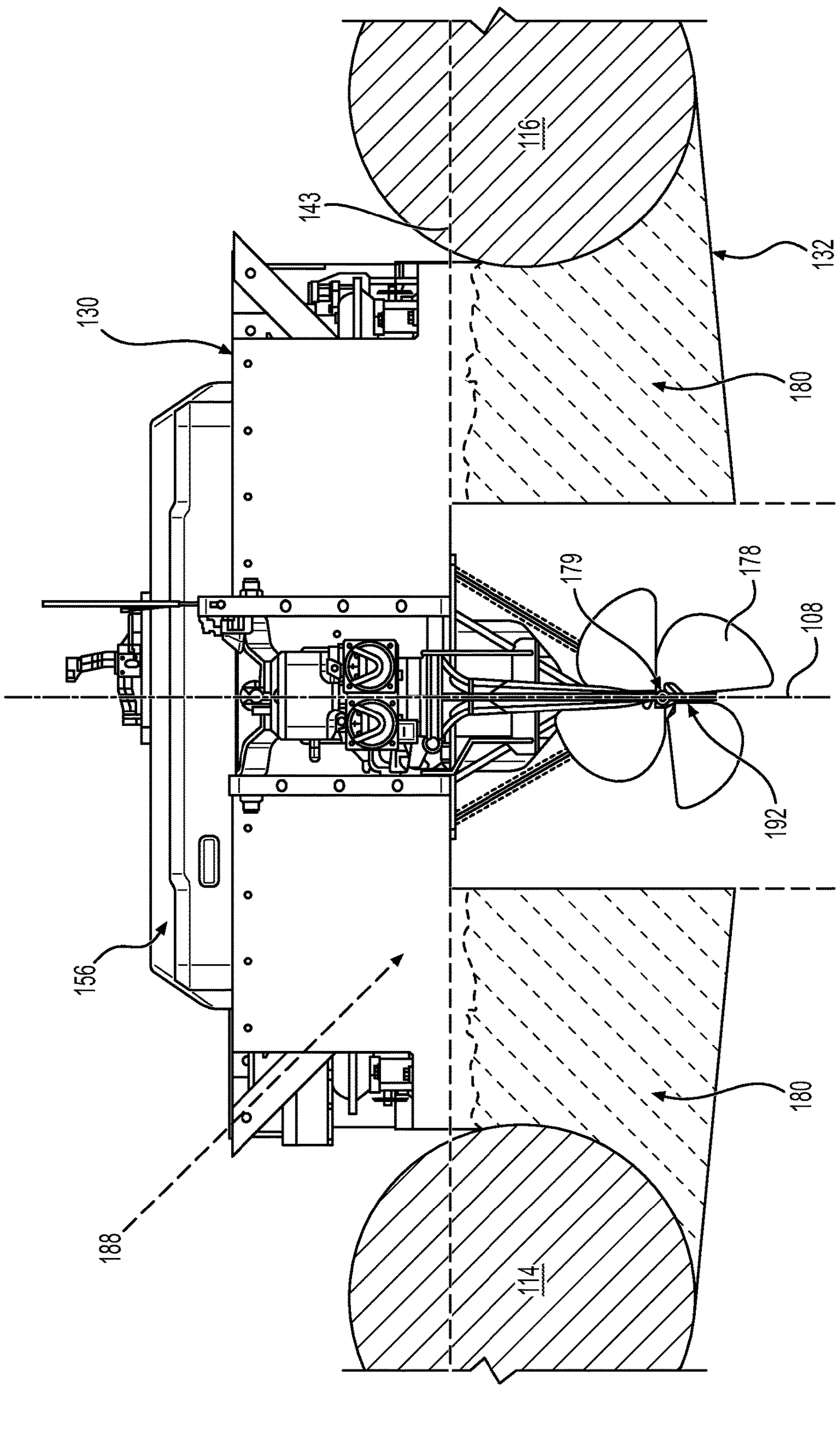

FIG. 9

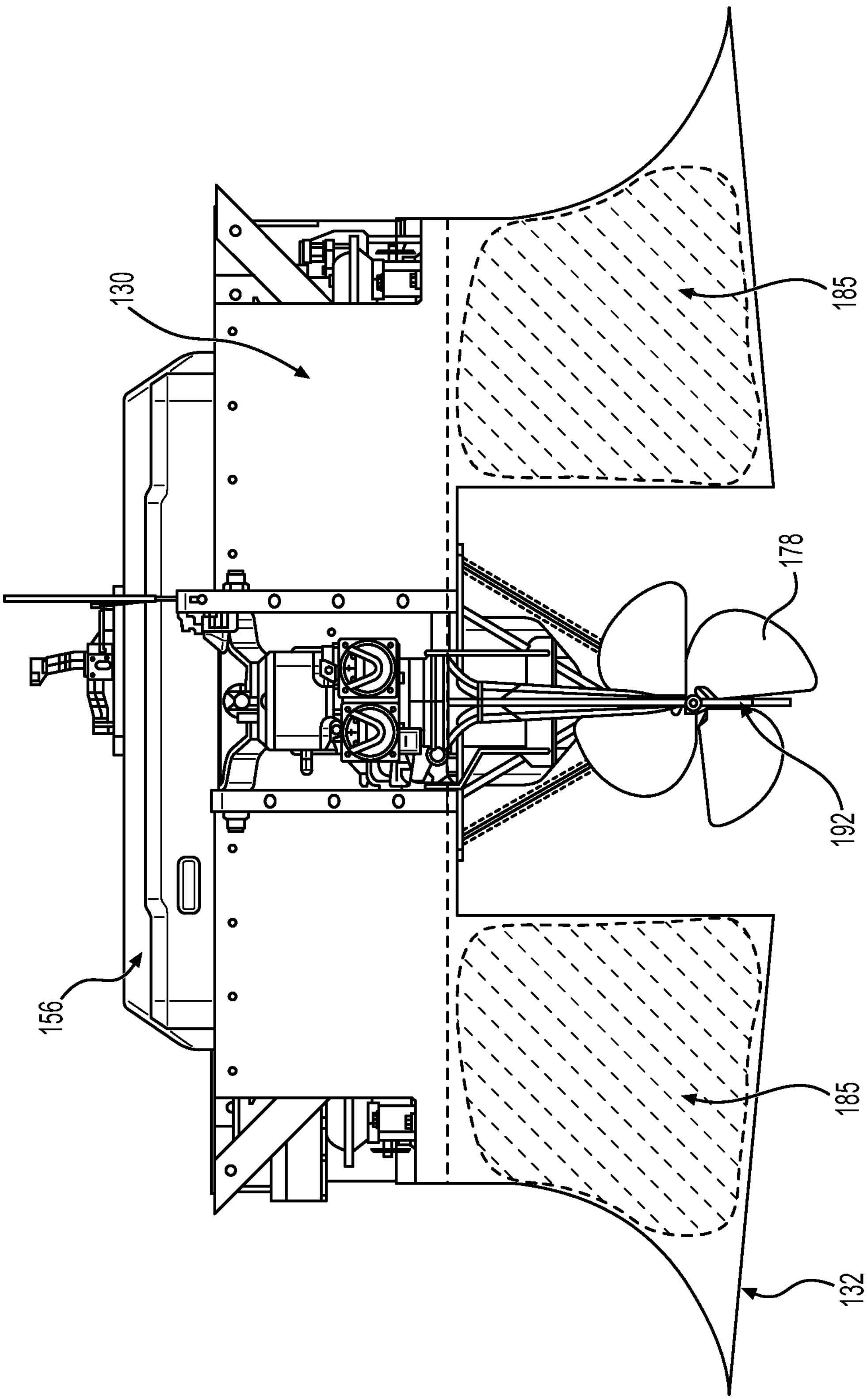

FIG. 10

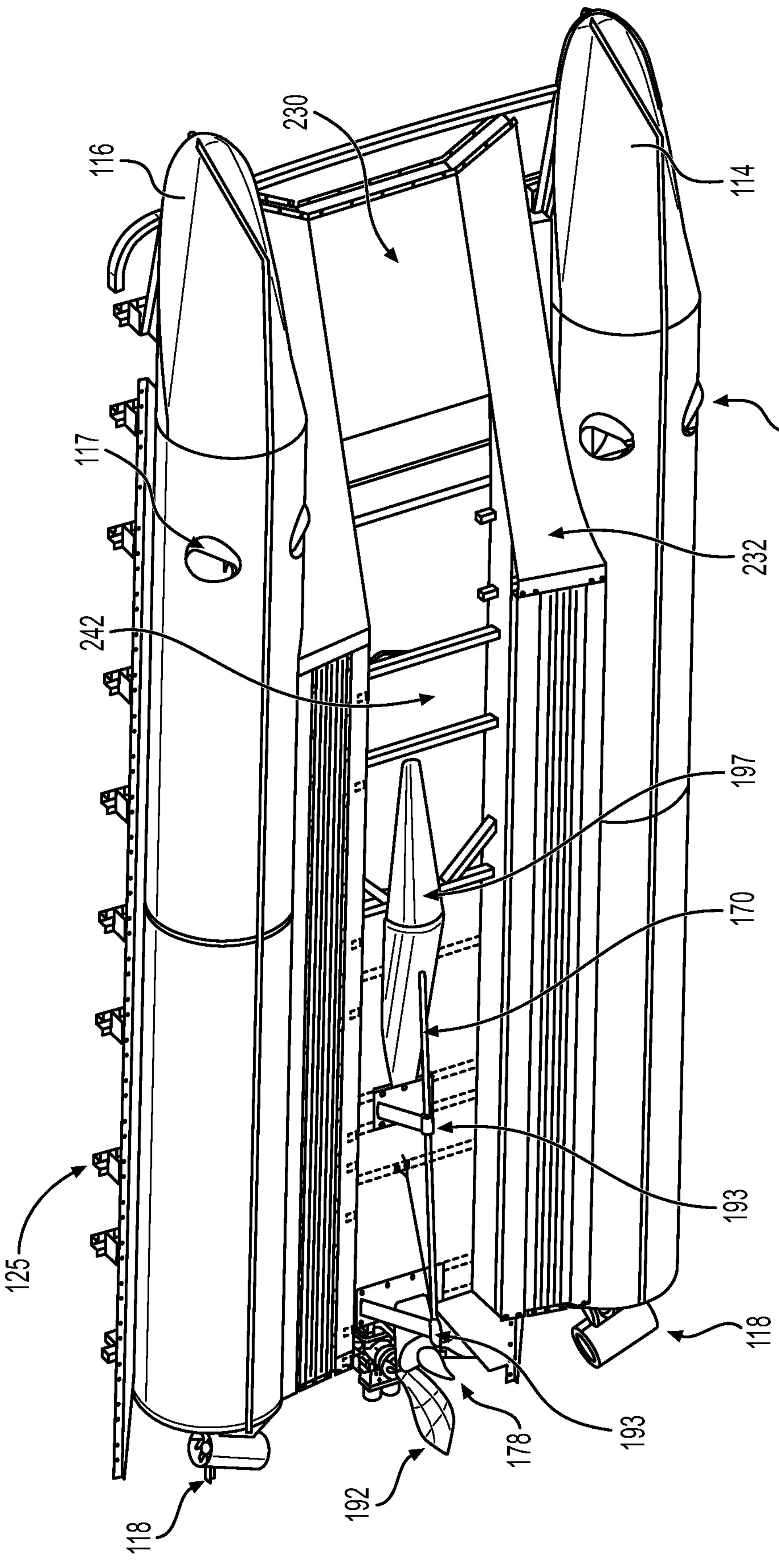

FIG. 11

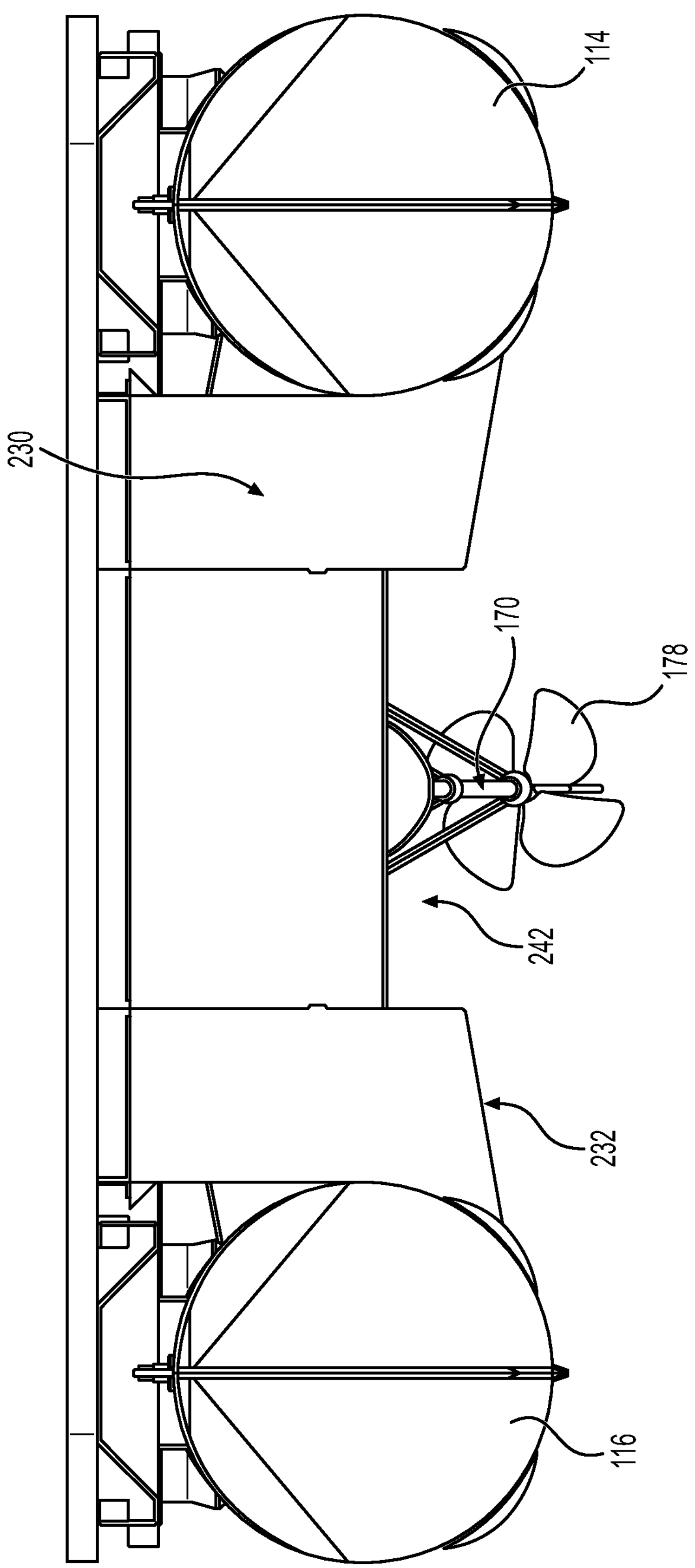

FIG. 12

WATERCRAFT WITH AN ELECTRIC MOTOR

CROSS-REFERENCE

The present application claims priority to U.S. Provisional Patent No. 63/182,440, entitled "Watercraft with an Electric Motor," filed Apr. 30, 2021, the entirety of which is incorporated herein by reference.

FIELD OF TECHNOLOGY

The present technology relates to watercraft, and more specifically to watercraft having an electric motor.

BACKGROUND

In watercraft, hydrodynamic drag exerted on the watercraft's hull as it moves through water may consume a substantial portion of the watercraft power and energy. At lower speeds, drag is usually greater as the watercraft travels lower in the water. Many watercraft are thus generally configured to get "on plane" at higher speeds, wherein the watercraft rides mostly above the water and thereby reduces hydrodynamic drag significantly.

Recreational watercraft with electric propulsion systems tend to be significantly heavier than similar watercraft having conventional powertrains, which generally results in the watercraft sitting lower in the water, thereby increases hydrodynamic drag. The added weight can further make it harder for the watercraft to get on plane. This challenge is even greater for large recreational marine vessels, such as pontoons. As the electric watercraft has greater drag, due to both the lower position in water and reduced time on plane, energy from the battery is consumed by drag at a substantial rate thereby decreasing the overall range of the watercraft.

As interest grows in converting recreational vehicles to electric propulsion systems, solutions have been proposed for retrofitting pontoon boats with an electric propulsion system. Some such electric pontoons replace a conventional gasoline powered outboard engine with an electric outboard engine with batteries or battery packs stored in the boat.

While retrofitting an existing pontoon boat limits the need for a full watercraft redesign, battery pack placement is constrained to existing storage spaces in the boat. Using the existing storage locations, however, limits the size and number of battery packs utilized and may not allow for an optimal weight distribution. In addition to boat handling, non-optimal weight distribution can also further impact the ability of the watercraft to get on plane.

Thus, there is a desire for a recreational watercraft designed for an electric propulsion system with improved range.

SUMMARY

It is an object of the present technology to ameliorate at least some of the inconveniences present in the prior art.

According to one aspect of the present technology, there is provided a watercraft with an electric propulsion system, formed from a deck and hull with the electric powertrain being received in part between the hull and the deck. The hull structure provides a relatively large volume for the watercraft to counteract the weight of the electric powertrain and to decrease the hull surface area in the water to decrease drag at low speeds. The volume formed between the hull and the deck receives the electric motor, the battery, and other

electric components, with the different components being arranged to aid in providing suitable weight distribution. The hull also includes inclined panels in a forward portion thereof to further aid the watercraft into getting on plane during operation. With the electric motor disposed in a forward portion of the watercraft, a propulsion shaft extends into a channel in the hull to provide inboard drive for the propeller, with the battery being disposed in a rear portion to balance the weight distribution. Components disposed in the volume between the hull and the deck are also configured to be waterproof, such that the hull need not be sealably connected to the hull and the pontoon tubes, reducing the complexity of construction for the watercraft. Waterproof buoyant material is further included to aid in increasing buoyancy.

According to an aspect of the present technology, there is provided a watercraft including a hull including a bottom surface, a channel being defined by the bottom surface; a deck disposed above the hull; a battery disposed in a rear portion of the watercraft, the battery being disposed above the bottom surface of the hull and below the deck; an electric motor disposed in a forward portion of the watercraft, the electric motor being disposed above the bottom surface of the hull and below the deck, the electric motor being electrically connected to the battery; a propulsion shaft operatively connected to the electric motor at a front end of the propulsion shaft, the propulsion shaft extending downward and rearward from the electric motor, the propulsion shafting passing through the bottom surface of the hull and extending into the channel; a propeller connected to a rear end portion of the propulsion shaft; and a rudder pivotally connected to at least one of the hull and the deck.

In some embodiments, the bottom surface of the hull includes: a first portion including at least one inclined surface extending downward and rearward from a front edge portion of the bottom surface; and a second portion extending rearward from the first portion at an angle from the first portion.

In some embodiments, the at least one inclined surface includes: a right surface section disposed laterally between the channel and the right tube, and a left surface section disposed laterally between the channel and the left tube.

In some embodiments, an interior angle formed by the at least one inclined surface and the second portion of the bottom surface is at least 140 degrees.

In some embodiments, the interior angle formed by the at least one inclined surface and the second portion of the bottom surface is approximately 160 degrees.

In some embodiments, a front edge of the first portion is a connected to a bottom surface of the deck.

In some embodiments, a longitudinal length of a horizontal projection of the first portion is equal to at least 20% of an overall length of the watercraft.

In some embodiments, the channel is defined in at least the second portion of the bottom surface.

In some embodiments, the channel is further defined in the first portion of the bottom surface.

In some embodiments, a shaft aperture is defined in the hull; and the propulsion shaft extends through the shaft aperture.

In some embodiments, the shaft aperture is defined in a portion of the bottom surface defining the channel.

In some embodiments, a drive axis is defined by a line extending through the front end of the propulsion shaft, and a center of rotation of the propeller and the drive axis extends downward and rearward from the deck at a drive angle of less than 15 degrees.

In some embodiments, the drive angle is approximately 11 degrees.

In some embodiments, the channel extends along a longitudinal center plane of the watercraft.

In some embodiments, the propulsion shaft extends along the longitudinal center plane of the watercraft.

In some embodiments, the watercraft further includes buoyant material disposed between the hull and the deck.

In some embodiments, the electric motor and the battery are disposed vertically higher than the buoyant material.

In some embodiments, at least one area of contact between the hull and the deck is water-permeable.

In some embodiments, a plurality of electrical components are disposed between the hull and the deck; the plurality of electrical components include at least the battery and the electric motor; and the plurality of electrical components are configured to be water-proof.

In some embodiments, the propulsion shaft includes a drive shaft operatively connected to the electric motor; a propeller shaft connected to the propeller; and a coupling connecting the propeller shaft to the drive shaft.

In some embodiments, the propeller is disposed at least partially rearward of the channel.

In some embodiments, the battery and the electric motor are disposed vertically over the channel.

In some embodiments, a longitudinal length of the hull is at least 4 meters.

In some embodiments, a longitudinal length of the hull is less than 8 meters.

In some embodiments, the hull is a multihull including at least: a left hull, and a right hull; and the channel is defined between the left hull and the right hull.

In some embodiments, the hull includes a surface extending above the channel and between the left hull and the right hull; and the battery and the electric motor are received on the surface.

In some embodiments, a width of the channel is approximately 25% of a total width of the watercraft.

For purposes of this application, terms related to spatial orientation such as forwardly, rearwardly, longitudinally, upwardly, downwardly, laterally, left, and right, are as they would normally be understood by an operator in the watercraft and facing a bow of the watercraft. Terms related to spatial orientation when describing or referring to components or sub-assemblies of the watercraft, separately from the watercraft, should be understood as they would be understood when these components or sub-assemblies are mounted to the watercraft, unless specified otherwise in this application.

As used herein, the term "approximately" in the context of a given value or range refers to a value or range that is within 10% of the given value or range.

Embodiments of the present technology each have at least one of the above-mentioned object and/or aspects, but do not necessarily have all of them. It should be understood that some aspects of the present technology that have resulted from attempting to attain the above-mentioned object may not satisfy this object and/or may satisfy other objects not specifically recited herein.

Additional and/or alternative features, aspects and advantages of embodiments of the present technology will become apparent from the following description, the accompanying drawings and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

For a better understanding of the present technology, as well as other aspects and further features thereof, reference is made to the following description which is to be used in conjunction with the accompanying drawings, where:

FIG. **1** is a front, right side perspective view of a watercraft according to a non-limiting embodiment of the present technology;

FIG. **2** is a rear, right side perspective view of the watercraft of FIG. **1**;

FIG. **3** is a bottom, front, right side perspective view of the watercraft of FIG. **1**;

FIG. **4** is a top, rear, left side perspective view of the watercraft of FIG. **1**, with a deck removed;

FIG. **5** is a top, rear, left side perspective view of pontoon tubes and a support structure of the watercraft of FIG. **1**;

FIG. **6** is a top plan view of the watercraft of FIG. **1**, with the deck removed;

FIG. **7** is a top, rear, left side perspective view of a hull, propulsion system, and a rudder of the watercraft of FIG. **1**;

FIG. **8** is a cross-sectional view of the hull, the propulsion system, and the rudder of FIG. **7**;

FIG. **9** is a rear elevation view of the hull, the propulsion system, and the rudder of FIG. **7**, with an embodiment of buoyant material illustrated schematically;

FIG. **10** is a rear elevation view of the hull, the propulsion system, and the rudder of FIG. **7**, with another embodiment of buoyant material illustrated schematically;

FIG. **11** is a bottom, right side perspective view of another embodiment of a hull for a watercraft, with the pontoon tubes and the support structure of FIG. **4**; and

FIG. **12** is a rear elevation view of the hull, the pontoon tubes, and the support structure of FIG. **11**.

It should be noted that the Figures may not be drawn to scale.

DETAILED DESCRIPTION

A watercraft **100** in accordance with one embodiment of the present technology is shown in FIGS. **1** to **3**. The following description relates to one example of a watercraft, notably a pontoon boat **100** with an inboard electric propulsion system **150**. Those of ordinary skill in the art will recognize that there are other known types of watercrafts incorporating different designs and that at least some aspects of the present technology would encompass these other watercrafts.

The watercraft **100** has a front end **102**, also referred as a bow **102**, and a rear end **104**, also referred to as a stern **104**. A longitudinal center axis **106** of the watercraft **100** is defined from the front end **102** to the rear end **104**. A longitudinal center plane **108** is also defined for the watercraft **100**, as is also illustrated in FIG. **9**. The longitudinal center plane **108** is aligned with the center axis **106** from the front end **102** to the rear end **104** and extends vertically to transect the watercraft **100** into two lateral halves, left and right.

The watercraft **100** includes a pair of sealed pontoon tubes, also referred to as pontoons: a left tube **114** and a right tube **116**. Each tube **114**, **116** includes a rear-mounted thruster **118** and a forward thruster **117** disposed in a forward portion of the tubes **114**, **116** for aiding in handling operation of the watercraft **100**. In some embodiments, one or both of the thrusters **117**, **118** could be omitted.

The watercraft **100** includes a deck **120** supported by the tubes **114**, **116**. The deck **120** is formed from a composite polymer panel covered by watercraft carpeting, although the particular materials forming the deck **120** could vary in different embodiments. For example, wood panels could be used to for the deck **120**, as is common in conventional pontoon boats. The deck **120** has an upper surface for supporting occupants, as well as accessories and accommodations of the watercraft **100** (e.g., seating, command console, etc.). In this embodiment, the deck **120** receives thereon various railing structures **121** and seating structures **122**, although the particular arrangement could vary from the illustrated embodiment.

With additional reference to FIGS. **4** to **6**, the present embodiment of the watercraft **100** includes a support structure **125** extending between the tubes **114**, **116** for receiving the deck **120**. The support structure **125** and the tubes **114**, **116** are illustrated in isolation in FIG. **5**. The support structure **125** is formed from two left longitudinal rigid members **127** connected to the left tube **114**, two right longitudinal rigid members **127** connected to the right tube **116**, twenty brackets **123**, commonly referred to as deck risers, and ten lateral rigid members **128**, commonly referred to as deck risers. Each lateral member **128** is connected by its end portions to the right and left rigid members **127** by one of the brackets **123**. It is contemplated that more or fewer rigid members **127**, **128** could be utilized in different embodiments of the support structure **125**. It is also contemplated that in some embodiments of the watercraft **100**, elements of the support structure **125** could be omitted, such as the deck risers, or that the support structure **125** could be omitted in its entirety. For example, the deck **120** could be configured and arranged to connect directly to the tubes **114**, **116**.

The watercraft **100** also includes a hull **130** disposed below the deck **120** and between the left and right tubes **114**, **116**. The hull **130** is connected to a bottom side of the deck **120** near the front and rear ends **102**, **104** of the watercraft **100** and to the pair of tubes **114**, **116**. As will be described further below, the hull **130** is not sealed to the deck **120** and the tubes **114**, **116** and thus these seams are generally water-permeable. It is contemplated that the hull **130** could be connected to the deck **120** and/or the tubes **114**, **116** with rivets, bolts and/or welds, although other means of connection are possible. In some embodiments, it is also contemplated that the hull **130** could be connected directly to the support structure **125**. It is also contemplated that the hull **130** could be connected to only the deck **120** or only the tubes **114**, **116**. It is further contemplated that in some embodiments, the tubes **114**, **116** could be omitted and compensated for by the hull **130**. In such embodiments, the hull **130** could be formed to occupy a volume equal to that of the tubes **114**, **116** and the hull **130** of the illustrated embodiments.

With additional reference to FIGS. **7** to **9**, between the hull **130**, the deck **120**, and the tubes **114**, **116** is defined a volume **188** of the watercraft **100** in which are received components of the inboard electric propulsion system **150** and buoyant material, as will be described in further detail below. While not sealing edges of the hull **130** to the deck **120** and the tubes **114**, **116** reduces complexity of construction of the watercraft **100**, some infiltration of water into the volume **188** is possible. As will be discussed below, however, the watercraft **100** is configured to allow infiltration during normal operation.

The hull **130** has a bottom surface **132** arranged to contact water when the watercraft **100** is in use. The bottom surface **132** includes two integrally connected portions: a forward portion **134** and a rearward portion **136**. The bottom surface **132** extends between the tubes **114**, **116** and defines a channel **142** in the hull **130**. The channel **142** is defined partially in both the forward and rearward portions **134**, **136** as will be described in further detail below.

The forward portion **134** of the bottom surface **132** of the hull **130** extends downward and rearward from a front edge **129** in contact with the deck **120** to provide an angled bottom surface portion. The rearward portion **136** extends rearward from the forward portion **134** at an angle to the forward portion **134**. Specifically, the rearward portion **136** is arranged generally horizontally and parallel to the deck **120**. An interior angle **199** formed by the forward portion **134** and the rearward portion **136** is at least 140 degrees (see FIG. **8**). In the present embodiment, the interior angle **199** is approximately 160 degrees.

As shown in FIG. **3**, the forward portion **134** includes a right surface section **137** disposed laterally between the channel **142** and the right tube **116**, and a left surface section **139** disposed laterally between the channel **142** and the left tube **114**. Each of the right surface section **137** and the left surface section **139** is an inclined surface extending downward and rearward from the front edge portion **129** of the bottom surface **132** and arranged at the interior angle **199** to the rearward portion **136**. The surfaces **137**, **139** also incline and extend downward and inward laterally from the tubes **114**, **116** toward the center plane **108**. The inclined surface sections **137**, **139** aid the watercraft **100** in achieving an on plane condition, in order to aid in reducing drag and thus power consumption.

The forward portion **134** also includes a center portion **135** disposed between the right surface section **137** and the left surface section **139** and centered on the center plane **108**. The center portion **135** includes an inclined forward portion **165** extending downward from the front edge **129** and a generally horizontal portion **166** extending rearward from the portion **165** and defining a forward part of the channel **142**. It is contemplated that the forward portion **134** could include only one inclined surface in some embodiments, for example an angled surface extending forward of the channel **142** and along the right and left sides thereof.

It should be noted that the term "rearward" for the rearward portion **136** is employed simply to denote that the portion **136** is disposed rearward of the forward portion **134**. As can be seen from the Figures, the rearward portion **136** of the present embodiment extends partially forward of a longitudinal midpoint of the watercraft **100**. In particular, a longitudinal length **144** of a horizontal projection of the forward portion **134** is equal to approximately at least 20% of an overall longitudinal length **146** of the watercraft **100** and/or the hull **130**. In the present embodiment, the overall length **146** of the hull **130** is approximately 6 meters. The exact length **146** could vary in different embodiments, with the length **146** preferably being at least 4 meters and less than 8 meters.

As is mentioned above, the hull **130** has the channel **142** defined therein by the bottom surface **132**. The channel **142** extends along the bottom of the watercraft **100** and is centered on the longitudinal center plane **108**. The channel **142** is defined by and extends through the rearward portion **136** and a rear part of the forward portion **134**, specifically by horizontal portion **166** between the inclined surfaces **137**, **139**. It is contemplated, depending on the exact dimensions of the watercraft **100** and the forward and rearward portions **134**, **136**, that the channel **142** could be defined by only the rearward portion **136** in some embodiments.

Briefly, the channel **142** aids in providing adequate water flow to an inboard motor-driven propeller **178**, disposed slightly rearward of the channel **142**. The exact width of the channel **142** could therefore depend on various factors, including but not limited to: operational details of the propeller **178**, size and weight of the watercraft **100**, and other hydrodynamic factors. A maximum width **145** of the channel **142** (see additionally FIG. **9**) of the present embodiment, defined at the laterally widest point of the channel **142** is approximately 600 mm and is approximately 25% an overall width **147** of the watercraft **100**. The channel width **145** is generally less than 30% of a total width of the hull **130**. Depending on the embodiment, the exact maximum width **145** could vary, although the width **145** is generally at least 400 millimeters for a similar embodiment of the hull **130**.

As can be further seen in FIGS. **3** and **9**, the bottom surface **132** extends laterally inward and downward from each tube **114**, **166** toward the channel **142**. FIGS. **11** and **12** illustrate another embodiment a hull **230**, with a different arrangement of a channel **242** and a bottom surface **232**. In the embodiment of the hull **230**, the channel **242** is wider and shallower than the channel **140**, with the bottom surface **232** extending slightly upward as it extends inward from the tubes **114**, **116**. This forms a slightly shallower channel **242**, with the channel **242** also being slightly wider than the channel **142**. The exact form of the bottom surface **132** or **232** used in any given embodiment of the watercraft **100** could depend on numerous details specific to the embodiment of the watercraft **100**, including but not limited to: weight of the watercraft **100**, operational details of the propeller **178**, and other hydrodynamic factors. It is contemplated, for example, that another embodiment of a hull could have a differently shaped bottom surface, include the form of the channel and the angles (in both lateral and longitudinal orientations) of the inclined surfaces. While the cross-sectional shapes of the channels **142**, **242** illustrated herein are generally rectangular in form, it is also contemplated that the cross-sectional shape of the channel could vary in different embodiments.

While the hull **130** is described herein as a hull having a channel, it is contemplated that the illustrated embodiment could also be considered a watercraft **100** having a multi-hull **130**. Considered in this terminology, the multi-hull **130** would then include a left hull **107** and a right hull **109** (identified thusly in FIG. **3**), with the channel **142** defining the space between the hulls **107**, **109**.

In FIGS. **6** to **8**, the inboard electric propulsion system **150** propelling the watercraft **100** is illustrated. The propulsion system **150** is disposed below the deck **120**, with portions of the system **150** being received in the volume **188** defined between the hull **130**, the deck **120**, and the tubes **114**, **116**.

The propulsion system **150** includes a plurality of electrical components disposed between the hull **130** and the deck **120**. As is mentioned above, seams formed at boundaries between the hull **130**, the deck, and/or the tubes **114**, **116** are not necessarily sealed and are water-permeable. As such, the electrical components of the system **150** are waterproof to an Ingress Protection Code standard of IP67. It is contemplated that different standards could be applied, depending on the particular embodiment or desired application.

The plurality of electrical components of the system **150** include an electric motor **152** disposed in a forward portion of the watercraft **100**. The electric motor **152** is disposed above the bottom surface **132** of the hull **130** and below the deck **120**. More specifically, the motor **152** is disposed between the hull **130** and the support structure **125** in the present embodiment. An acceleration lever (not shown) is operatively connected to the electric motor **152** for controlling operation of the motor **152**. The acceleration lever is located on a command console (not illustrated), also referred to as a helm, provided on the deck **120**. It is contemplated that different input and control mechanisms could be used for controlling the motor **152** by an operator.

In order to power the motor **152**, the electronic components of the system **150** also include a battery pack **156**, referred to herein generally as the battery **156**, disposed in a rear portion of the watercraft **100**. Similarly to the motor **152**, the battery **156** is disposed above the bottom surface **132** of the hull **130** and below the deck **120**. As can be seen in FIG. **4**, a majority of the battery **156** extends under the support structure **125** in the present embodiment, with a portion extending upward between two of the lateral rigid members **128**. The exact arrangement of the battery **156** and the support structure **125** could vary in different embodiments, depending on the arrangement of the support structure **125** and the configuration of the battery **156**. The electric motor **152** is electrically connected to the battery **156** by a plurality of waterproof power supply cables (not illustrated) although the number and style of electrical connection between the motor **152** and the battery **156** could vary.

Both the battery **156** and the electric motor **152** are disposed vertically over the channel **142**, supported by a receiving surface **189** formed by a top surface of the hull **130** where it extends over the channel **142**. When considering the hull **130** as the multi-hull **130**, the receiving surface **189** extends above the channel **142** and between the left hull **107** and the right hull **109**. As can be seen in FIG. **7**, the battery **156** is connected to a battery support structure **186** connected to the surface **189**, although connection details relating to the battery **186** could vary for different embodiments.

In the illustrated embodiment the watercraft **100** has a center of buoyancy **101** located in a center region of the watercraft **100** (see in FIG. **6**). The exact position of the center of buoyancy **101** could vary in different embodiments. By positioning the electric motor **152** (as well as additional components **157**, **159**, **161**, **162**, **163**, **164** described below) in a forward portion of the watercraft **100**, forward of the center of buoyancy **101**, and the battery **156** in a rear portion of the watercraft **100**, rearward of the center of buoyancy **101**, the weight of the electrical propulsion system **150** is distributed through the watercraft **100**.

The propulsion system **150** further includes electronic management and conversion components communicatively connected to the motor **152**, as can be seen in at least FIG. **6**. These components include a DC-DC converter **157** that provides current for the low voltage electronics and a charger unit **159** disposed to the right of the motor **152**. The electronic components also include a regulator unit **161** that regulates power distribution, an inverter **162**, a thruster system battery **163** for powering the thrusters **117**, **118**, and a boost converter **164** disposed to the left of the motor **152**. The exact arrangement of the motor **152** and the electronic components **157**, **159**, **161**, **162**, **163**, **164** could vary in different embodiments.

It is contemplated that the watercraft **100** could also include additional and/or alternative electronic or electrical components, for example, for controlling the propulsion system **150** and for managing operation of the watercraft **100**. These components could include, but are not limited to, electronic cooling system, passenger accessory systems, navigation systems, watercraft control systems, and communication systems.

The propulsion system **150** includes a propulsion shaft **170** operatively connected to the electric motor **152** for driving the propeller **178**. A front end **172** of the propulsion shaft **170** is connected and driven by the motor **152**. From the front end **172** at the motor **152**, the propulsion shaft **170** extends downward and rearward from the motor **152** toward the rear **104** of the watercraft **100** along the longitudinal center plane **108**. As will be described further below, the propulsion shaft **170** passes from inside the hull **130** outward into the channel **142**, thereby connecting the motor **152** disposed inside the volume **188** to the propeller **178** arranged to be submerged when the watercraft **100** is in operation.

The propeller **178** is connected to and supported by a rear end portion **174** of the propulsion shaft **170**. The propeller **178** is disposed generally rearward of the channel **142**, although precise longitudinal placement of the propeller **178** could vary for different embodiments. The propeller **178** is a four blade, fixed-pitch propeller which rotates about a center of rotation **179**, although the particular form of the propeller **178** could vary.

The watercraft **100** also includes a rudder **192** pivotally connected to the hull **130** behind the propeller **178**. In some embodiments, the rudder **192** could be additionally or alternatively pivotally connected to a rear portion of the deck **120**. A steering wheel (not shown) on a command console (not illustrated) on the deck **120** is operatively connected to the rudder **192**. It is contemplated that the steering wheel could be replaced by a handlebar in some embodiments.

As can be seen in FIG. **8**, the propulsion shaft **170** is formed from a driveshaft **173** operatively connected to the motor **152** and a propeller shaft **175** connected to the propeller **178**. A coupling **177**, also referred to as an aquadrive **177**, connects the propeller shaft **175** to the driveshaft **173**. The coupling **177** allows for a small relative movements between the propeller shaft **175** and the driveshaft **173** to aid in impeding transfer of vibration from the propeller **178** to the motor **152**. The coupling **177** further provides for a small relative angle between the axes of rotation of the propeller shaft **175** and the drive shaft **173**, such that the propeller shaft **175** is closer to horizontal without requiring a shallower angle of the drive shaft **173** as it extends from the motor **152**.

A drive axis **171** is defined for the watercraft **100** which describes the overall angle at which the propulsion shaft **170** is arranged in the watercraft **100**. The drive axis **171** is defined by a line **171** extending through the front end **172** of the propulsion shaft **170** and through the center of rotation **179** of the propeller **178**. As is illustrated, the drive axis **171** does not necessarily align with the driveshaft **173** and/or the propeller shaft **175**, as the coupling **177** allows for the small relative angle between the axes of rotation of the two shafts **173**, **175**. The drive axis **171** extends downward and rearward from the deck **120** at a drive angle **181** of less than 15 degrees to the deck **120**. In the present embodiment, the drive angle **179** is approximately 11 degrees. Placement of the motor **152** in the forward portion of the watercraft **100**, in addition to optimizing weight distribution, further aids in minimizing relative angling of portions the propulsion shaft **170** and to provide a preferred angle for the drive axis **171**.

The propulsion shaft **170** extends through a shaft aperture **131** in the hull **130** and into the channel **142**. The shaft aperture **131** is defined in a portion of the bottom surface **132** defining a top of the channel **142**. As can be seen in FIGS. **3** and **8** for the hull **130** and in FIG. **11** for the hull **230**, the watercraft **100** includes a coupler recess **197** which protrudes into a top side of the channel **142**. In the present embodiment, the shaft aperture **131** is defined in a rear side of the coupler recess **197**. The propeller shaft **175** passes through the shaft aperture **131**, as the coupling **177** is disposed in the recess **197** in the receiving surface **189**. The coupling **177** is thereby disposed lower than a topmost point of the channel **142** while reducing drag that would otherwise be caused by the coupler **177** extending into the channel **142**. It is contemplated that the coupling **177** could be arranged above the channel **142** and the recess **197** omitted in some embodiments. Rearward of the recess **197** and the shaft aperture **131**, the propeller shaft **175** is supported by two journal bearing support structures **193**. In some embodiments, more or fewer supports **193** could be included or additional and/or alternative mechanisms for supporting the propulsion shaft **170** could be employed.

As is illustrated schematically in FIG. **9**, the watercraft **100** further includes buoyant material **180** disposed between the hull **130** and the deck **120**, within the volume **188**. The buoyant material **180** is included in the present embodiment in order to maintain buoyancy in case of water infiltration into the volume **188**. As is mentioned above, the hull **130** is not sealably connected to the deck **120** and/or the tubes **114**, **116** in order to reduce the complexity of construction of the watercraft **100**. It is noted that the volume **188** itself aids in increasing the buoyancy of the watercraft **100** to aid in compensating for the weight of the electric propulsion systems **150**, compared to a standard pontoon with a combustion-based propulsion system, and it is contemplated that the buoyant material **180** could be omitted in embodiments where the volume **188** is sealed to be waterproof.

The buoyant material **180** fills lower portions of the volume **188**. The volume **188** is generally separated into two zones by a channel top plane **143**, which is defined by a plane **143** passing laterally through a top-most point of the channel **142**. The buoyant material **180** is received in portions of the volume **188** below the channel top plane **143**. The receiving surface **189** is above the channel top plane **143**, such that the electronic equipment, including the motor **152** and the battery **156**, is disposed above and separated from the buoyant material **180**. In some embodiments, there could additionally be a physical barrier between these regions.

In the embodiment of FIG. **9**, the buoyant material **180** is marine floatation foam **180**. The foam **180** is installed in the watercraft **100** by spraying a foam-mixture into lower portions of the volume **188**, which then expands to fill the lower portions as the flotation foam **180** sets. The marine floatation foam **180** maintains buoyancy of the watercraft **100** and is water-resistant so that water infiltrating the volume **188** is not absorbed by the material therein and does not decrease buoyancy of the watercraft **100**. It is contemplated that different kinds of foam could be used in some embodiments, for example pre-formed blocks of marine floatation foam or other types of closed-cell foam. FIG. **10** illustrates another embodiment a buoyant material disposed in the lower portion of the volume **188**, specifically two waterproof air bladders **185**. As is mentioned above, in some embodiments the hull **130** could be sealed such that water could not infiltrate into the volume **188**.

It is further contemplated that portions of the present technology could be applied in retrofitting an existing pontoon boat to produce the electric watercraft **100**. Specifically, the hull **130**, with the electric propulsion system **150** connected thereto, could be connected to an existing deck and pair of pontoon tubes connected there.

Modifications and improvements to the above-described embodiments of the present technology may become apparent to those skilled in the art. The foregoing description is intended to be exemplary rather than limiting. The scope of the present technology is therefore intended to be limited solely by the scope of the appended claims.

What is claimed is:

1. A watercraft comprising:
a hull including a bottom surface, a channel being defined by the bottom surface;
a deck disposed above the hull;
a battery disposed in a rear portion of the watercraft, the battery being disposed rearward of a center of buoyancy of the watercraft, the battery being disposed above the bottom surface of the hull and below the deck;
an electric motor disposed in a forward portion of the watercraft, the electric motor being disposed above the bottom surface of the hull and below the deck, the electric motor being electrically connected to the battery;
a propulsion shaft operatively connected to the electric motor at a front end of the propulsion shaft, the propulsion shaft extending downward and rearward from the electric motor, the propulsion shaft passing through the bottom surface of the hull and extending into the channel;
a propeller connected to a rear end portion of the propulsion shaft; and
a rudder pivotally connected to at least one of the hull and the deck.

2. The watercraft of claim 1, wherein the bottom surface of the hull includes:
a first portion including at least one inclined surface extending downward and rearward from a front edge portion of the bottom surface; and
a second portion extending rearward from the first portion at an angle from the first portion.

3. The watercraft of claim 2, further comprising:
a right pontoon tube disposed to a right of the hull and below the deck; and
a left pontoon tube disposed to a left of the hull and below the deck:
wherein the at least one inclined surface includes:
a right surface section disposed laterally between the channel and the right pontoon tube, and
a left surface section disposed laterally between the channel and the left pontoon tube.

4. The watercraft of claim 2, wherein an interior angle formed by the at least one inclined surface and the second portion of the bottom surface is at least 140 degrees.

5. The watercraft of claim 4, wherein the interior angle formed by the at least one inclined surface and the second portion of the bottom surface is approximately 160 degrees.

6. The watercraft of claim 2, wherein a front edge of the first portion is a connected to a bottom surface of the deck.

7. The watercraft of claim 2, wherein a longitudinal length of a horizontal projection of the first portion is equal to at least 20% of an overall length of the watercraft.

8. The watercraft of claim 2, wherein the channel is defined in one of: at least the second portion of the bottom surface, or in the first portion of the bottom surface and the second portion of the bottom surface.

9. The watercraft of claim 1, wherein:
a shaft aperture is defined in the hull; and
the propulsion shaft extends through the shaft aperture.

10. The watercraft of claim 1, wherein:
a drive axis is defined by a line extending through:
the front end of the propulsion shaft, and
a center of rotation of the propeller; and
the drive axis extends downward and rearward from the deck at a drive angle of less than 15 degrees.

11. The watercraft of claim 1, wherein the channel extends along a longitudinal center plane of the watercraft.

12. The watercraft of claim 1, further comprising buoyant material disposed between the hull and the deck.

13. The watercraft of claim 12, wherein the electric motor and the battery are disposed vertically higher than the buoyant material.

14. The watercraft of claim 12, wherein at least one area of contact between the hull and the deck is water-permeable.

15. The watercraft of claim 1, wherein the propeller is disposed at least partially rearward of the channel.

16. The watercraft of claim 1, wherein a longitudinal length of the hull is at least 4 meters and less than 8 meters.

17. The watercraft of claim 1, wherein:
the hull is a multihull including at least:
a left hull, and
a right hull; and
the channel is defined between the left hull and the right hull.

18. The watercraft of claim 17, wherein:
the hull includes a surface extending above the channel and between the left hull and the right hull; and
the battery and the electric motor are received on the surface.

19. The watercraft of claim 1, wherein a width of the channel is approximately 25% of a total width of the watercraft.

20. A watercraft comprising:
a hull including a bottom surface, a channel being defined by the bottom surface;
a deck disposed above the hull;
a battery disposed in a rear portion of the watercraft, the battery being disposed above the bottom surface of the hull and below the deck;
an electric motor disposed in a forward portion of the watercraft, the electric motor being disposed above the bottom surface of the hull and below the deck, the electric motor being electrically connected to the battery;
a propulsion shaft operatively connected to the electric motor at a front end of the propulsion shaft, the propulsion shaft extending downward and rearward from the electric motor, the propulsion shaft passing through the bottom surface of the hull and extending into the channel;
a propeller connected to a rear end portion of the propulsion shaft, the propeller being disposed at least partially rearward of the channel; and
a rudder pivotally connected to at least one of the hull and the deck.

21. The watercraft of claim 1, wherein the battery is centered on a longitudinal center plane of the watercraft.

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