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United States Patent	12389893
Kind Code	B2
Date of Patent	August 19, 2025
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Motor-driven fishing reel

Abstract

A reel system includes a fishing reel including a spool, an electrical module, and a multi-gear system. The electrical module is coupled to the fishing reel. The electrical module includes a motor configured to turn the spool. A first position in the multi-gear system is configured to turn the spool via the motor.

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Appl. No.:	17/495904
Filed:	October 07, 2021

Prior Publication Data

Document Identifier	Publication Date
US 20220110305 A1	Apr. 14, 2022

Related U.S. Application Data

us-provisional-application US 63089123 20201008

Publication Classification

Int. Cl.: A01K89/017 (20060101); A01K89/015 (20060101); G06F3/16 (20060101); H04M1/72409 (20210101)

U.S. Cl.:

CPC **A01K89/017** (20130101); **A01K89/0183** (20150501); G06F3/167 (20130101);
H04M1/72409 (20210101)

Field of Classification Search

CPC: A01K (89/017); A01K (89/0183); A01K (89/0184); A01K (89/0155); A01K (89/00);
A01K (89/047); A01K (89/056); A01K (89/02); A01K (89/033); A01K (89/045); A01K
(89/046); A01K (91/20); G06F (3/167); H04M (1/72409)

USPC: 242/250

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Background/Summary

PRIORITY CLAIM AND CROSS-REFERENCE TO RELATED APPLICATIONS (1) This application claims priority to, and the benefit of, U.S. Provisional Patent App. No. 63/089,123, filed Oct. 8, 2020, entitled NOVEL ELECTRICAL FISHING REEL DESIGN, the entire contents of which are incorporated by reference herein and relied upon.

FIELD

(1) The present invention relates to systems for fishing reels. More specifically, the invention relates to the incorporation of a frameless brushless direct current motor, reel sensors, related intelligent controls, improved dual-drag, and a level wind system, providing a smart reel that can be controlled through smart phones or integrated with a boat's electronic systems.

BACKGROUND

(2) Fishing reels have been around for hundreds of years. The overall concept of fishing reels have remained relatively constant: a spool to hold line, a friction system to resist rotation, and a lever to turn the spool. Through the years, there have been some improvements to each of these systems.

(3) Particularly, in recent years, improvements to materials (e.g., aluminum, carbon fiber, titanium, and the like) have led to lighter and more agile fishing reels. Advancements in design configurations have similarly led to reduction in weight and improved strength. In general, reels are becoming both smaller and more powerful. Reduced size and increased power are especially important with certain popular types of fishing lines, such as spectra and fiber lines.

(4) That said, the fishing reel space has lots of room for improvement. While some companies offered power-assisted reeling, the power modules cannot be easily attached/detached from reel systems. Some reels include sensing technology (e.g., motor power sensing), but the sensing is nonetheless rudimentary. Reels also lack many connectivity features that are readily available in other products in today's world.

(5) For these reasons, among others, improved fishing reels are therefore needed.

SUMMARY

(6) The fishing reel systems disclosed herein improve on current reel technology in a number of meaningful ways. The disclosed fishing reels implement a frameless brushless direct current motor, that can be easily attached (and detached) from the reel itself. Via this frameless brushless direct current motor, the reel is afforded multiple drive capabilities, such as reel speed control. Further, the fishing reels herein implement a number of sensors to deliver meaningful metrics to the user (e.g., line distance calculation, torque calculation, among others). These fishing reels additionally display said metrics, along with other data, via a user interface; the fishing reels, likewise, offer connectivity to external devices such as smart phones. Beyond these benefits, there are a number of additional benefits and improvements, disclosed more fully herein.

(7) In light of the disclosure, and without limiting the scope of the invention in any way, in a first aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, a reel system includes a fishing reel including a spool, an electrical module, and a multi-gear system. The electrical module is coupled to the fishing reel. The electrical module includes a motor configured to turn the spool. In a first position of the multi-gear system, the motor is configured to turn the spool.

(8) In a second aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the motor is a brushless direct current motor.

(9) In a third aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the motor and the spool are magnetically coupled via a contactless coupler system, such that the motor turns the spool magnetically.

(10) In a fourth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the electrical module is removable from the fishing reel with one hand.

(11) In a fifth aspect of the present disclosure, which may be combined with any other aspect listed

herein unless specified otherwise, a second position and a third position in the multi-gear system are configured to turn the spool via manual effort.

(12) In a sixth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes an electrical sensor.

(13) In a seventh aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the electrical sensor is configured to measure spool revolutions.

(14) In an eighth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the electrical module further includes a user interface.

(15) In a ninth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the user interface is configured to display reel metrics including one or more of spool rotations, motor torque, power supplied to motor, line speed, line distance, and line tension.

(16) In a tenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes a speaker, wherein the speaker is configured to audibly communicate one or more reel metrics.

(17) In an eleventh aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes a transmitter, such that reel metrics are communicated to an external device such as a smartphone, tablet, or other electronic device.

(18) In a twelfth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the smartphone, tablet, or other electronic device controls the reel system, along with a plurality of additional reel systems.

(19) In a thirteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes a drag lever system that is actuated by a servo motor.

(20) In a fourteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the fishing reel includes drag surfaces that are disposed at an angle, relative to a spool axis.

(21) In a fifteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, a reel system includes a fishing reel including a spool, an electrical module, and a handle. The electrical module is coupled to the fishing reel at a first end. The electrical module includes a brushless direct current motor configured to turn the spool. The handle is coupled to the fishing reel at a second end. The handle is configured for manual winding of the spool.

(22) In a sixteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the electrical module is removable from the fishing reel with one hand.

(23) In a seventeenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes a multi-gear system. A first position in the multi-gear system is configured to turn the spool via the motor without engaging the handle. A second position in the multi-gear system is configured to turn the spool via manual effort.

(24) In an eighteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the reel system further includes an electrical sensor, configured to measure spool revolutions.

(25) In a nineteenth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the electrical module further includes a user interface.

(26) In a twentieth aspect of the present disclosure, which may be combined with any other aspect listed herein unless specified otherwise, the user interface is configured to display reel metrics

including one or more of spool rotations, motor torque, power supplied to motor, line speed, line distance, and line tension.

(27) Additional features and advantages of the disclosed devices, systems, and methods are described in, and will be apparent from, the following Detailed Description and the Figures. The features and advantages described herein are not all-inclusive and, in particular, many additional features and advantages will be apparent to one of ordinary skill in the art in view of the figures and description. Also, any particular embodiment does not have to have all of the advantages listed herein. Moreover, it should be noted that the language used in the specification has been selected for readability and instructional purposes, and not to limit the scope of the inventive subject matter.

Description

BRIEF DESCRIPTION OF THE FIGURES

(1) Understanding that figures depict only typical embodiments of the invention and are not to be considered to be limiting the scope of the present disclosure, the present disclosure is described and explained with additional specificity and detail through the use of the accompanying figures. The figures are listed below.

(2) FIG. 1 illustrates a perspective view of an electrical module side of a fishing reel, according to an example embodiment of the present disclosure.

(3) FIG. 2 illustrates a perspective view of a locking mechanism, according to an example embodiment of the present disclosure.

(4) FIG. 3 illustrates an exploded perspective view of a reel with an electrical module, according to an example embodiment of the present disclosure.

(5) FIG. 4 illustrates an exploded rear view of the reel with the electrical module removed, according to an example embodiment of the present disclosure.

(6) FIG. 5 illustrates a perspective view of the reel with a right frame removed to expose a multi-gear shifting mechanism, according to an example embodiment of the present disclosure.

(7) FIG. 6 illustrates a side cross-section view of a gear shifting mechanism, according to an example embodiment of the present disclosure.

(8) FIG. 7 illustrates a side cross-section view of the gear shifting mechanism, according to an example embodiment of the present disclosure.

(9) FIG. 8 illustrates a perspective view of a level wind system, according to an example embodiment of the present disclosure.

(10) FIG. 9 illustrates an exploded perspective view of the level wind system, according to an example embodiment of the present disclosure.

(11) FIG. 10 illustrates an exploded perspective view the reel with a left frame removed to expose spool gearing and an anti-reverse ratchet, according to an example embodiment of the present disclosure.

(12) FIG. 11 illustrates a front view of spool and motor gearing, according to an example embodiment of the present disclosure.

(13) FIG. 12 illustrates a user interface screen, disposed on the electrical module, according to an example embodiment of the present disclosure.

(14) FIG. 13 illustrates an exploded perspective view of a reel plate, according to an example embodiment of the present disclosure.

(15) FIG. 14 illustrates an exploded perspective view of a mating face of the electrical module, according to an example embodiment of the present disclosure.

(16) FIGS. 15 to 16 illustrate perspective cross-section views of magnetic couplers, mated to the motor axle, according to example embodiments of the present disclosure.

(17) FIGS. 17 to 18 illustrate perspective views of non-contact sensors and magnets, according to

example embodiments of the present disclosure.

(18) FIG. 19 illustrates a perspective view of a reel with a servo motor, according to an example embodiment of the present disclosure.

(19) FIG. 20 illustrates a side view of a reel with a servo motor geared to a drag lever arm, according to an example embodiment of the present disclosure.

(20) FIG. 21 illustrates a side cross-section view of a drag cam system, according to an example embodiment of the present disclosure.

(21) FIG. 22 illustrates a side cross-section view of the drag cam system and servo gear, according to an example embodiment of the present disclosure.

(22) FIGS. 23 to 26 illustrate side cross-section views of various drag systems, according to example embodiments of the present disclosure.

DETAILED DESCRIPTION

(23) Example embodiments will now be described more fully with reference to the accompanying drawings.

(24) Example embodiments are provided so that this disclosure will be thorough, and will fully convey the scope to those who are skilled in the art. Numerous specific details are set forth such as examples of specific components, devices, and methods, to provide a thorough understanding of embodiments of the present disclosure. It will be apparent to those skilled in the art that specific details need not be employed, that example embodiments may be embodied in many different forms and that neither should be construed to limit the scope of the disclosure. In some example embodiments, well-known processes, well-known device structures, and well-known technologies are not described in detail.

(25) The terminology used herein is for the purpose of describing particular example embodiments only and is not intended to be limiting. As used herein, the singular forms “a,” “an,” and “the” may be intended to include the plural forms as well, unless the context clearly indicates otherwise. The terms “comprises,” “comprising,” “including,” and “having,” are inclusive and therefore specific the presence of stated features, integers, steps, operations, elements, and/or components, but do not preclude the presence or addition of one or more other features, integers, steps, operations, elements, components, and/or groups thereof. The method steps, processes, and operations described herein are not to be construed as necessarily requiring their performance in the particular order discussed or illustrated, unless specifically identified as an order of performance. It is also to be understood that additional or alternative steps may be employed.

(26) When an element or layer is referred to as being “on,” “engaged to,” “connected to,” or “coupled to” another element or layer, it may be directly on, engaged, connected or coupled to the other element or layer, or intervening elements or layers may be present. In contrast, when an element is referred to as being “directly on,” “directly engaged to,” “directly connected to,” or “directly coupled to” another element or layer, there may be no intervening elements or layers present. Other words used to describe the relationship between elements should be interpreted in a like fashion (e.g., “between” versus “directly between,” “adjacent” versus “directly adjacent”). As used herein, the term “and/or” includes any and all combinations of one or more of the associated listed items.

(27) Although the terms first, second, third, etc. may be used herein to describe various elements, components, regions, layers and/or sections, these elements, components, regions, layers and/or sections should not be limited by these terms. These terms may be only used to distinguish one element, component, region, layer or section from another region, layer or section. Terms such as “first,” “second,” and other numerical terms when used herein do not imply a sequence or order unless clearly indicated by the context. Thus, a first element, component, region, layer or section discussed below could be termed a second element, component, region, layer or section without departing from the teachings of the example embodiments.

(28) Spatially relative terms, such as “inner,” “outer,” “beneath,” “below,” “lower,” “above,”

“upper,” and the like, may be used herein for ease of description to describe one element or feature's relationship to another element(s) or feature(s) as illustrated in the figures. Spatially relative terms may be intended to encompass different orientations of the device in use or operation in addition to the orientation depicted in the figures. For example, if the device in the figures is turned over, elements described as “below” or “beneath” other elements or features would then be oriented “above” the other elements or features. Thus, the example term “below” can encompass both an orientation of above and below. The device may be otherwise oriented (rotated 90 degrees or at other orientations) and the spatially relative descriptors used herein interpreted accordingly.

(29) With reference to FIG. 1, a reel system **100** includes a fishing reel **102** with a spool **104**. While not illustrated, spool **104** is configured for fishing line to be wrapped about spool **104**. Fishing reel **102** further includes a handle **106**, for manual winding of spool **104**.

(30) Reel system **100** additionally includes an electrical module **108**, coupled to the fishing reel **102**. In an embodiment, electrical module **108** is coupled to a first end of fishing reel **102** and handle **106** is coupled to a second end of fishing reel **102**. Electrical module **108** includes a motor **110**, configured to wind the spool **104**. In an embodiment, motor **110** is a frameless brushless direct current motor that can operate at varying speeds. For example, frameless motors may advantageously provide for integration of motor **110** directly into the housing of fishing reel **102** or electrical module **108**. In an example, the housing of fishing reel **102** functions as a heat sink for the motor **110**. In an alternate embodiment, motor **110** is a standard brushless direct current motor with a frame.

(31) Motor **110** may be powered by a removable power source, such as one or more Li-ion batteries. Alternatively, motor **110** and electrical module **108** may be powered by an external power source (e.g., plugged into a boat's battery system). Electrical module **108** may additionally include a user interface **112** (described in greater detail herein with respect to FIG. 12). For example, user interface **112** may include a power cable outlet, such that user interface **112** (and thus electrical module **108**) may be electrically coupled to an external power source. In various embodiments, the power cable outlet is disposed parallel to or, alternatively, normal to the axis of spool **104**.

(32) As illustrated by FIG. 2, electrical module **108** further includes a locking mechanism **114**. In an embodiment, locking mechanism **114** is integrally formed with a housing of electrical module **108**. Namely, via locking mechanism **114**, the electrical module **108** (including motor **110**) is removable from fishing reel **102**. For example, a user can remove electrical module **108** from fishing reel **102** with one hand (via a twisting motion).

(33) More specifically, as illustrated by FIG. 3, locking mechanism **114** includes several rotation slots **116**. Similarly, the first end of fishing reel **102** includes several protrusions **118**. Protrusions **118** are configured to engage with slots **116**. For example, a user aligns protrusions **118** with slots **116**, and subsequently rotates electrical module **108** such that protrusions **118** translate within slots **116** to the distal ends of slots **116**. This advantageously ensures a snug fit between fishing reel **102** and electrical module **108**. In an embodiment, motor **110** and spool **104** are magnetically coupled to one another via a contactless coupler system, such that the motor **110** turns the spool **104** without exposing any gears within electrical module **108**.

(34) While the gears within electrical module **108** are self-contained, and thus not exposed to external elements such as wind and water, electrical module **108** may transfer power (e.g., from motor **110** to spool **104**) via a motor drive shaft **120** extending from the electrical module **108**. As illustrated by FIG. 4, motor drive shaft **120** includes a motor spur gear **122** at its distal end. The first end of fishing reel **102** includes an aperture **124** (illustrated by FIG. 3), which is configured to receive the motor spur gear **122** (e.g., when the electrical module **108** is coupled to the fishing reel **102**). In an embodiment, aperture **124** self-seals; for example, when the motor spur gear **122** is removed from aperture **124**, aperture **124** remains sealed from the external environment, such that no foreign materials, like water, can enter the side of fishing reel **102**.

(35) As noted previously, handle **106** is coupled to the second end of fishing reel **102**. FIGS. 5 and 6 illustrate additional features on this side of reel system **100**, including a multi-gear system **126**. In an embodiment, multi-gear system **126** includes three drive positions: a first position, a second position, and a third position. The first position is configured for motorized winding; for example, when the first position is engaged, motor **110** is used to wind spool **104**. In an embodiment, the first position is a “neutral” gear, such that multi-gear system **126** is effectively disengaged from spool **104** (e.g., disengaged at handle **106**). The second position and the third position are configured for manual winding; for example, when the second position is engaged, a user can manually wind spool **104** via handle **106** in a “low speed mode.” Similarly, for example, when the third position is engaged, a user can manually wind spool **104** via handle **106** in a “high speed mode.” This three-gear configuration, with the first position being a “neutral” gear, is generally illustrated by FIG. 7. The various gears in the multi-gear system **126** are selectable via a shifter button **128** and a shifter body **130**. For example, a user can push/pull shifter button **128** to engage/disengage the shifter body from various gears within multi-gear system. As illustrated by FIG. 7, for example, position 1 indicates that the shifter body **130** may be disposed in neutral, such as when motor **110** is in use. Position 2 indicates that shifter body **130** may be engaged with a gear for high speed mode. Position 3 indicates that shifter body **130** may be engaged with a gear for low speed mode.

(36) As illustrated by FIGS. 8 to 9, reel **102** additionally includes a level wind assembly **150** coupled to the frame of reel **102**. The level wind assembly **150** is geared to a lower ratio than the spool **104**. Namely, spool **104** (rotating at a first rate) turns a level wind gearing system as spool **104** rotates, and this level wind gearing system ends with diamond shaft spur gear **152** (rotating at a second, different rate). Diamond shaft spur gear **152** turns a shaft **154** (e.g., a diamond shaft) that subsequently rotates. A guide block **156** is coupled to the diamond shaft **154**. The guide block **156** includes a pawl that slides along a groove **158** of the diamond shaft **154**. This causes the guide block **156** to transverse along the axis of the diamond shaft **154** as the diamond shaft **154** (and spool **104**) rotate. Thus, as spool **104** rotates at a first speed, guide block **156** translates laterally back and forth across spool **104** at a second, lower speed. Guide block **156** is configured to ensure that line will lay evenly as it is wrapped onto spool **104**. Namely, guide block **156** includes guide pins **160**, such that line is wrapped onto spool **104** between guide pins **160**. By ensuring that level wind assembly is geared to a lower ratio than the spool, the reliability of system **100** is improved as it requires less torque (e.g., via the user and handle **106**, or via motor **110**) to move the level wind system and particularly to move the guide block.

(37) Continuing on, FIG. 10 illustrates an exploded view of spool **104** with a portion of the left frame removed, to expose gearing. As shown, motor spur gear **122** extending from motor **110** engages with a spool gear **132**, such that rotational motion from motor **110** is transferred to spool gear **132**. Spool gear **132** further includes an integrated anti-reverse ratchet **134**. Via the anti-reverse ratchet **134**, spool gear **132** can only be turned in one direction. This engagement between motor spur gear **122** and spool gear **132** is further illustrated by FIG. 11.

(38) FIG. 12 illustrates the user interface **112**, disposed on electrical module **108**. Generally, user interface **112** is configured to display reel metrics, such as spool rotations (e.g., spool rotations per minute), motor torque, power supplied to the motor, line speed, line tension, line distance, and other related metrics. These metrics are identified via one or more sensors (discussed in greater detail herein). For example, when the motor **110** is in operation, the user interface **112** can display the amount of power being used by motor **110**. User interface **112** may additionally include a processor and memory. The processor may be configured to execute software to calculate additional reel metrics. For example, via a calculation of power, the user interface **112** could also display the amount of torque being applied by the motor **110**. Similarly, the processor could calculate the diameter of the line on the spool **104** with the known revolutions of the spool **104** and the combination inputs of the line diameter and total revolutions of line on the spool **104**. With this information, the total amount of drag on the spool **104** can be calculated/displayed, and thus the

force on the line can be calculated/displayed. Force on the line is one particular metric that is extremely beneficial to a user while fighting a fish. This allows the user to more confidently apply pressure to the fish without pulling the hook or breaking the line. It also allows the user to know how much pressure is applied, regardless of how much line is released from the reel **102**. This force calculation can be dynamically displayed onto user interface **112**.

(39) In an embodiment, electrical module **108** further includes a speaker. The speaker is configured to audibly communicate one or more reel metrics to a user. For example, the speaker could beep or alarm if the spool **104** is losing line, if the spool **104** has changed direction, if there has been a reduction in force on the line, and other related metrics. This can alert the user if they have stepped away from the reel **102** during operation.

(40) In an embodiment, the electrical module **108** further includes a transmitter. Namely, via the transmitter, reel metrics can be communicated to an external device, such as a smartphone, tablet, or other electronic device. In an embodiment, the external device is a display on a boat, such as a navigation panel or other maritime display device. In an embodiment, the external device is configured to control the reel system **100**. For example, a single external device can control the motor **110** of reel system **100** (along with a number of additional reel systems and related motors). This allows for a user to move multiple reels at the push of a button or, alternatively, on a reel-by-reel basis. Further, this embodiment allows one individual to control the reel system **100** from multiple locations on the boat. The captain can be at the helm or in the tower and retrieve the lines. This then frees the rest of the crew to complete other critical tasks on the boat.

(41) FIGS. **13** and **14** illustrate a primary embodiment previously disclosed above. Namely, electrical module **108** further includes a locking mechanism **114**. Via locking mechanism **114**, the electrical module **108** is removable from fishing reel **102**. For example, a user can remove electrical module **108** from fishing reel **102** with one hand (via a twisting motion). Locking mechanism **114** includes several rotation slots **116**. Similarly, the first end of fishing reel **102** includes several protrusions **118**. Protrusions **118** are configured to engage with slots **116**. For example, a user aligns protrusions **118** with slots **116**, and subsequently rotates electrical module **108** such that protrusions **118** translate within slots **116** to the distal ends of slots **116**. This advantageously ensures a snug fit between fishing reel **102** and electrical module **108**.

(42) In an alternate embodiment, FIGS. **15** and **16** illustrate that the motor and spool are magnetically coupled to one another via a contactless coupler system, such that the motor turns the spool without exposing any gears within electrical module.

(43) Specifically, these two figures illustrate an alternate reel **202** and electrical module **208**. The reel **202** may include a reel plate with protrusions, configured to engage with rotation slots (similar to the engagement previously discussed above). That said, reel **202** and electrical module **208** are different from the reels previously discussed herein, because electrical module **208** does not include a drive shaft extending from the electrical module **208**; similarly, reel **202** does not include an aperture (e.g., configured to receive a motor spur gear).

(44) Rather, in the embodiment illustrated by alternate reel **202** and electrical module **208**, the motor disposed within electrical module **208** is configured to drive the spool of reel **202** via magnetism. For example, the motor disposed within electrical module **208** and the spool of fishing reel **202** are magnetically coupled via a contactless coupler system, such that the motor turns the spool without engaging or exposing any gears within electrical module **208**. By preventing moving parts (e.g., between the spool and the motor), this alternate reel **202** and electrical module **208** are even more protected from external elements such as wind and water. Furthermore, eliminating moving parts (e.g., between the spool and the motor) allows for different assemblies, with varying features, to be attached and detached from the reel **202**. Additionally, this embodiment eliminates the need to seal the motor shaft, improving overall reliability with respect to lifetime seal requirements.

(45) FIGS. **15** to **16** illustrate perspective cross-section views of this magnetic coupling. Namely,

motor **210** spins a first magnetic coupler **212**, disposed within electrical module **208**. First magnetic coupler **212** is mated to the motor axle of motor **210**. First magnetic coupler **212** is configured to magnetically rotate (e.g., via its polarity configuration) a second magnetic coupler **214** that is disposed within alternate reel **202**. Thus, rotation from motor **210** is transferred to alternate reel **202** while avoiding mechanical interface (e.g., gearing) between alternate reel **204** and motor **210**.

(46) Returning now to the primary embodiment, to provide reel metrics as discussed above, reel system **100** requires one or more sensors. For example, as illustrated by FIGS. **17** to **18**, to provide for a line counting metric, a sensor **136** will need to monitor the rotation of the spool **104**; this sensor **136** is affixed to a stationary object (e.g., adjacent to spool **104**) and measure a target **138** that is attached to the spool **104**. In this particular embodiment, sensor **136** provides for contactless line counting to identify precisely how much line has been removed from the spool **104**. Specifically, by using an encoder (e.g., sensor **136**) placed adjacent to the spool **104**, rotations can be precisely monitored without adding any friction to spool **104**. This allows for improved reeling speed while simultaneously reducing the heat created by undesirable friction. In an embodiment, sensor **136** is a Hall Effect sensor with related circuit board. By counting revolutions directly on spool **104** (as opposed to revolutions of any other gears, which may be rotating at different rates), the system **100** provides for rotation-determination that is agnostic to any other moving components (e.g., handle RPM, motor RPM, gearing RPM, etc.). For example, this allows for reels without level winds to still have critical metrics. With reduced features, such as the level wind, system reliability is improved, weight is reduced, and friction to freespool is minimal.

(47) In an embodiment, sensor **136** can be used, with the processor and memory discussed above, to calculate the tension on the line. Namely, spool **104** rotation can be calculated as discussed above. Furthermore, system **100** can determine metrics associated with motor **110**, such as motor current draw and/or motor power draw. Given known factors, such as motor torque and gearing ratio, system **100** can further calculate spool torque. Additionally, given the system **100** has calculated spool rotations, it can further determine the amount of line on/off the spool **104** at any given time. Thus, given torque and gearing ratio, coupled with amount of line on spool, the system can solve for tension on the line. Users now have increased control on setting the hook, applying maximum pressure on the fish without pulling the hook or breaking the line.

(48) System **100** can additionally use these metrics for greater control of motor **110**. For example, if the user instructs a particular line speed for motor **110**, but the fish is pulling the line out, the motor **110** will slow down or stop. If the fish were to turn and the line can be retrieved, the motor **110** will pick up speed back up to retrieve the line. This configuration allows the reel system **100** to retrieve line when it can, and rest when it cannot retrieve line, ensuring the drag system and motor **110** do not overheat. This configuration also helps keep a steady pressure on the fish when fighting, potentially improving the catch success and reducing the fight time. Automating the speed of motor **110** ensures the user does not have to adjust motor **110** whatsoever during a fight.

(49) In various embodiments, sensor **136** and/or additional sensors are configured to measure at least one of torque at the fishing reel **102**, force at the fishing reel **102**, and spool revolutions at the fishing reel **102**. In an embodiment, sensor **136** is a force sensor, such as a strain gauge, disposed along the spool shaft or at any other location (e.g., adjacent to the spool). For example, a force sensor is configured to measure the load (e.g., at the spool) regardless of whether reel **102** includes motor **110**. Thus, via a force sensor, reel system **100** could calculate force on line, even if motor **110** is removed. In an embodiment, reel system **100** further includes a temperature sensor. Monitoring the temperature of the motor ensures that motor operation does not exceed motor limits. The same is true for temperature sensing on the electronic drive board.

(50) To the extent the system **100** is a non-contact system for measuring rotations (e.g., via sensor **136** and target **138**), the sensing system can be attached to any non-motor-driven fishing reels. For example, sensing components can be provided as a separate attachment (similar to electrical module **108**), and can be easily attached and removed from non-motor-driven fishing reels, in order

to count the spool revolutions.

(51) FIGS. **19** and **20** illustrate additional drag features of reel system **100**. Namely, in an example embodiment, reel system **100** includes a servo motor **140** disposed on the second end of fishing reel **102** (e.g., adjacent to handle **106**). Servo motor **140** is configured to rotate a gear **142**, which is mechanically affixed to a periphery of a drag handle **144**. Namely, via this interface, the servo motor **140** is configured to actuate, and thus rotate, the drag handle **144**.

(52) By this particular configuration, line on the reel **102** can be automatically released and/or retrieved at the push of a button, such that the reel system **100** has the capability to be fully automated and function with no user actions (beyond the push of a button, e.g., at the user interface **112**). For example, to automatically release the line on the spool **104**, an electrical control can be used to actuate the drag lever arm **144** via servo **140**. Similarly, via this particular configuration, the tension or drag of the line on the reel **102** can be set and regulated. For example, as line goes out and spool diameter changes, the drag lever arm **144** can be moved by servo **140** to ensure that drag remains constant. In an embodiment, user interface **112** is a touch-screen. In an alternate embodiment, user interface **112** includes a plurality of mechanical buttons, knobs, and/or dials for control of reel **102**.

(53) As an example, this feature can be used while trolling. Specifically, the captain can deploy/retrieve his lines from the helm. This frees the crew to tend other critical tasks during the fishing process. While fighting a fish, a steady line tension can be maintained, which ensures a strong hookset and reduces risk of a lost fish. Depending on the direction the fish is moving relative to the reel, adjustments can be made automatically.

(54) FIGS. **20** and **21** illustrate side cross-section views of the drag cams **146** of reel system **100**. In an embodiment, drag cams **146** are actuated by an electrical system. In an embodiment, servo motor **140**, along with gear **142**, are configured to drive the drag handle **144** and thus the drag cams **146**. For example, this allows the drag pressure of the fishing reel **102** to go from zero drag to maximum drag with no user action (beyond the push of a button, e.g., at the user interface **112**). In an embodiment, drag cams **146** are configured for 360-degree drag adjustments. Namely, for example, drag handle **144** can be rotated 360-degrees about fishing reel **102**. The 360-degree drag adjustment provides for greater user-control of reel **102** (e.g., more fine-tuned drag adjustment). Having 360-degrees of drag adjustment allows for gradual pressure to be applied to the line while setting the hook on fish. This helps to ensure that the hook sets properly, and increases the catch success. A longer cam rotation also allows for a longer compression spring between the cam and the drag plates. Longer springs allow for less variability in the system as there is more room for thermal expansion or mechanical variance from manufacturing.

(55) Additionally, the user could further set a distance of how much line will be released via drag resistance, such that the drag adjusts and “stops” releasing line after a particular distance. Distance-based drag control may implement sensor **136** (as previously detailed above). In an alternate embodiment, drag cams **146** are operated manually by a user (e.g., via drag handle **144**). For example, the user can set a distance and the reel deploys automatically, so user can walk away from the reel and perform another task.

(56) For example, when drag handle **144** is rotated, manually or via servo motor **140**, drag cams **146** expand about their rotational axis; this expansion causes additional pressure on friction plates described in greater detail below.

(57) FIGS. **23** to **26** illustrate side cross-section views of various drag systems. Specifically, FIG. **23** illustrates a drag system **300**, generally oriented perpendicular to the axis of rotation of the spool **302**; the spool **302** in FIG. **23** is parallel to the axis of rotation across its entire length **304**. Drag system **300** includes drag plates **306**, which are configured to apply pressure to carbon fiber disks **308**. These carbon fiber disks **308** then apply frictional pressure to friction plates **310**. In this way, imparted lateral forces (e.g., along the axis of rotation of the spool **302**) are transmitted to frictional pressure on frictional plates **310**, thus creating drag on spool **302**. In an embodiment, carbon fiber

disks **308**, the drag plates **306**, and the spool **304** include removed portions (e.g., to improve heat-transfer characteristics of drag system **300**). In another embodiment, carbon fiber disks **308** include a thermal pad to improve heat-transfer characteristics (e.g., avoiding undesirable heat transfer to spool **304** and line on spool **304**).

(58) FIG. **24** illustrates a drag system **400**, generally oriented perpendicular to the axis of rotation of the spool **402**; the spool **402** in FIG. **24** has angled portions **403** and is parallel to the axis of rotation across a length **404**. Angled portions **403** advantageously increase overall the stiffness of spool **402**, allowing spool **402** to withstand higher compressive loads without deforming. Drag system **400** includes drag plates **406**, which are configured to apply pressure to carbon fiber disks **408**. These carbon fiber disks **408** then apply frictional pressure to friction plates **410**. In this way, imparted lateral forces (e.g., along the axis of rotation of the spool **402**) are transmitted to frictional pressure on frictional plates **410**, thus creating drag on spool **402**.

(59) FIG. **25** illustrates a drag system **500**, generally oriented at an angle, relative to the axis of rotation of the spool **502**; the spool **502** in FIG. **25** has angled portions **503** and is parallel to the axis of rotation across a length **504**. Angled portions **503** advantageously increase overall the stiffness of spool **502**. Drag system **500** includes drag plates **506**, which are configured to apply pressure to carbon fiber disks **508**. These carbon fiber disks **508** then apply frictional pressure to friction plates **510**. In this way, imparted lateral forces (e.g., along the axis of rotation of the spool **502**) are transmitted to frictional pressure on frictional plates **510**, thus creating drag on spool **502**. In the embodiment illustrated by FIG. **25**, drag plates **506**, carbon fiber disks **508**, and friction plates **510** are disposed at an angle relative to the axis of spool **502**, “away” from a center of spool **502**. Advantageously, angled drag plates **506**, carbon fiber disks **508**, and friction plates **510** improve the overall strength of drag system **500** with minimal weight addition.

(60) FIG. **26** illustrates a drag system **600**, generally oriented at an angle, relative to the axis of rotation of the spool **602**; the spool **602** in FIG. **26** is parallel to the axis of rotation across its entire length **604**. The parallel configuration may be implemented to ensure that spool **602** can carry the maximum amount of line (e.g., in a wound configuration). Drag system **600** includes drag plates **606**, which are configured to apply pressure to carbon fiber disks **608**. These carbon fiber disks **608** then apply frictional pressure to friction plates **610**. In this way, imparted lateral forces (e.g., along the axis of rotation of the spool **602**) are transmitted to frictional pressure on frictional plates **610**, thus creating drag on spool **602**. In the embodiment illustrated by FIG. **26**, drag plates **606**, carbon fiber disks **608**, and friction plates **610** are disposed at an angle relative to the axis of spool **602**, “toward” a center of spool **602**. Advantageously, angled drag plates **606**, carbon fiber disks **608**, and friction plates **610** improve the overall strength of drag system **600** with minimal weight addition. Given reels can be fished for an entire day, reducing the weight improves user stamina, reduces fatigue, and improves the overall experience of using the reel.

(61) While drag systems **500** and **600** depict straight-angled components (e.g., angled frictional plates **510** and **610**), it should be appreciated that other drag surfaces are contemplated herein. For example, in an alternate embodiment, one or more of the drag surfaces include multiple angles and/or are curved surfaces.

(62) In an embodiment, each of the drag systems discussed above are fully sealed, such that the drag systems are protected from external moisture and/or salt. It should be appreciated that any of the drag systems disclosed herein may be implemented by the reel system **100**. Sealing the drag system keeps moisture off of the friction surfaces and reduces the need to service the drag system.

(63) The foregoing description of the embodiments has been provided for purposes of illustration and description. It is not intended to be exhaustive or to limit the disclosure. Individual elements or features of a particular embodiment are generally not limited to that particular embodiment, but, where applicable, are interchangeable and can be used in a selected embodiment, even if not specifically shown or described. The same may also be varied in many ways. Such variations are

not to be regarded as a departure from the disclosure, and all such modifications are intended to be included within the scope of the disclosure.

Claims

1. A reel system, comprising: a fishing reel including a spool configured to hold a fishing line; an electrical module including a processor, a user interface, and a motor, wherein the processor is coupled to the fishing reel, wherein the user interface configured to display reel metrics including at least one of spool rotations, motor torque, power supplied to the motor, line speed, line tension, and line distance, wherein the user interface is further configured to receive an input from a user including an input of a line diameter, wherein the processor is configured to calculate an amount of the fishing line on the spool, a sensor configured to measure revolutions of the spool, the sensor in communication with the processor; and a multi-gear system, wherein in a first position of the multi-gear system, the motor is configured to turn the spool, wherein the processor is further configured to calculate tension through the input of the line diameter and at least one of the amount of the fishing line on the spool and revolutions of the spool.
2. The reel system of claim 1, wherein the motor is a brushless direct current motor.
3. The reel system of claim 2, wherein the motor and the spool are magnetically coupled via a contactless coupler system.
4. The reel system of claim 1, wherein the electrical module is removable from the fishing reel with one hand.
5. The reel system of claim 1, wherein a second position and a third position in the multi-gear system are configured to turn the spool via manual effort.
6. The reel system of claim 1, further comprising a speaker, wherein the speaker is configured to audibly communicate one or more reel metrics.
7. The reel system of claim 1, further comprising a transmitter configured to communicate reel metrics to an external device.
8. The reel system of claim 7, wherein the smartphone, tablet, or other electronic device controls the reel system, along with a plurality of additional reel systems.
9. The reel system of claim 1, further comprising a drag lever system that is actuated by a servo motor.
10. The reel system of claim 1, wherein the motor is configured to rotate and generate torque.
11. The reel system of claim 10, wherein the processor is configured to calculate torque through a motor current draw.
12. A reel system, comprising: a fishing reel including a spool configured to hold a fishing line; an electrical module including a processor, a user interface, and a motor, wherein the processor is coupled to the fishing reel at a first end, wherein the user interface is configured to display reel metrics including at least one of spool rotations, motor torque, power supplied to the motor, line speed, line tension, and line distance, wherein the user interface is further configured to receive an input from a user including an input of a line diameter, wherein the processor is configured to calculate an amount of the fishing line on the spool, a sensor configured to measure revolutions of the spool, the sensor in communication with the processor; and a handle, coupled to the fishing reel at a second end, wherein the handle is configured for manual winding of the spool, wherein the processor is further configured to calculate tension through the input of the line diameter and at least one of the amount of the fishing line on the spool and revolutions of the spool.
13. The reel system of claim 12, wherein the electrical module is removable from the fishing reel with one hand.
14. The reel system of claim 12, further comprising a multi-gear system, wherein a first position in the multi-gear system is configured to turn the spool via the motor without engaging the handle,

and wherein a second position in the multi-gear system is configured to turn the spool via manual effort via the handle.
