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(54) **WATERFOWL MOTION SIMULATION DEVICE**

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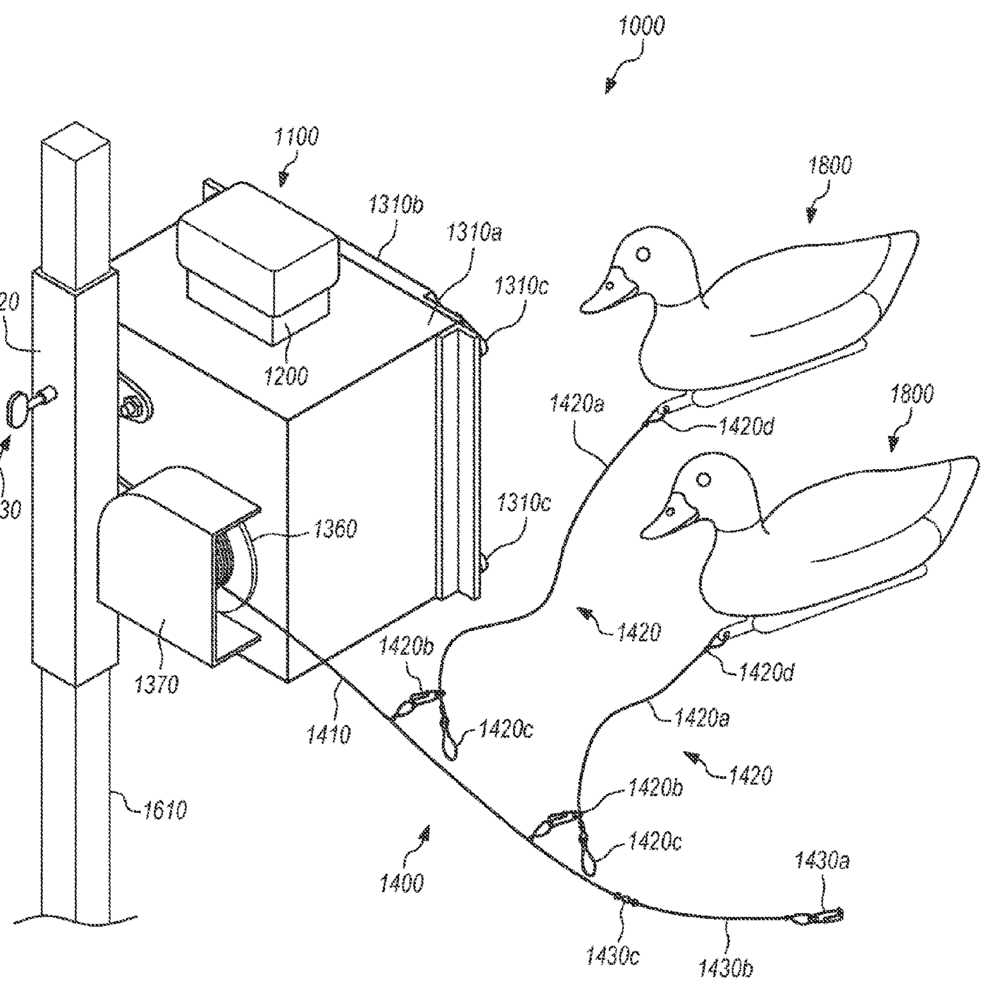
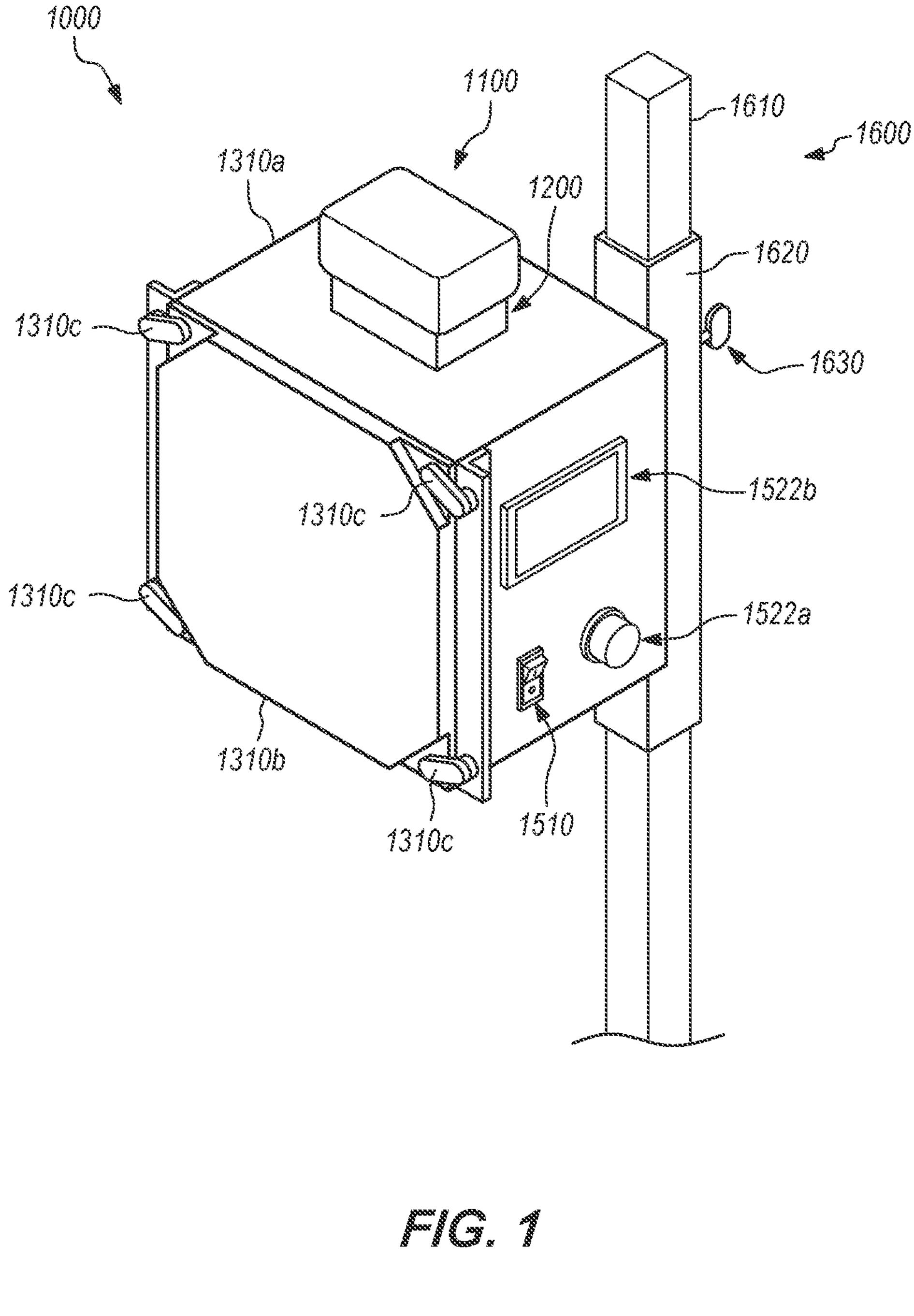
CPC ***A01M 31/06*** (2013.01); ***F16H 19/06*** (2013.01)

(57) **ABSTRACT**

A waterfowl motion simulation device for affecting the motion of waterfowl decoys in an aquatic terrain is disclosed. The waterfowl motion simulation device includes a winding unit configured to wind and unwind a line assembly. The line assembly includes a main line with a plurality of decoy attachment appendages provided at various points along its length. The winding unit includes a motor accommodated inside a winding unit housing, and a winding implement rotatably supported outside the winding unit housing by an output shaft of the motor. A control unit electrically connected to the motor is operable to control the rotation of the winding implement to wind and unwind the line assembly by controlling the motor according to a rotational speed and timing indicated by user input received through at least one user interface. A power supply unit is removably engaged with, and electrically connected to the control unit through, a power supply interface on an exterior surface of the winding unit housing. The waterfowl motion simulation device preferably also includes a mounting assembly configured to adjustably support at least in part the power supply unit, power supply interface, winding unit, and control unit above an aquatic terrain. A method of using the waterfowl motion simulation device to affect the motion of at least one waterfowl decoy in an aquatic terrain is also described.

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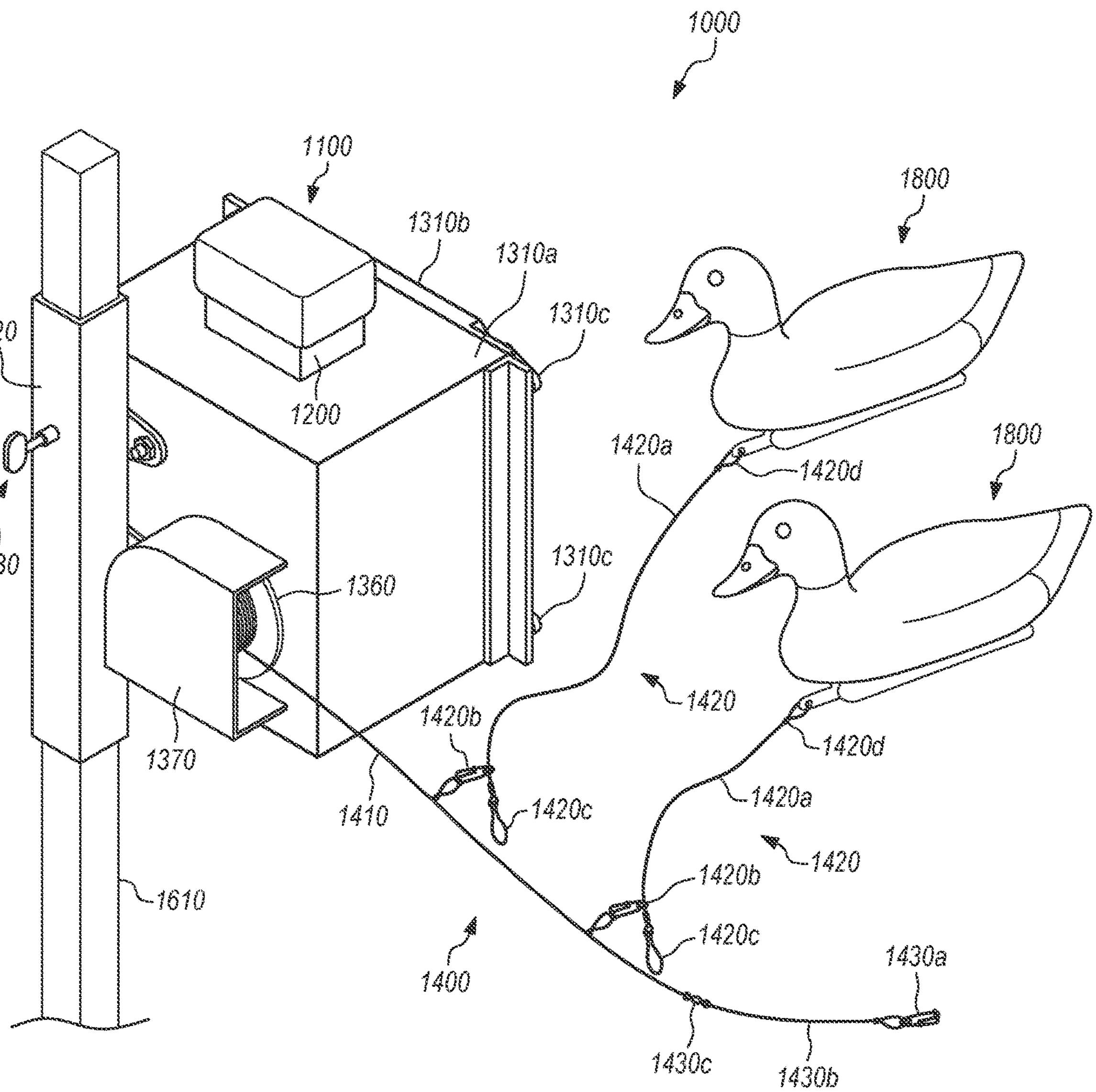
1100
1310a
1200
1610
1600
1620
1310c
1630
1310c
1522b
1310c
1522a
1310b
1310c
1510

FIG. 1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1200
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1420a
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1800
1630
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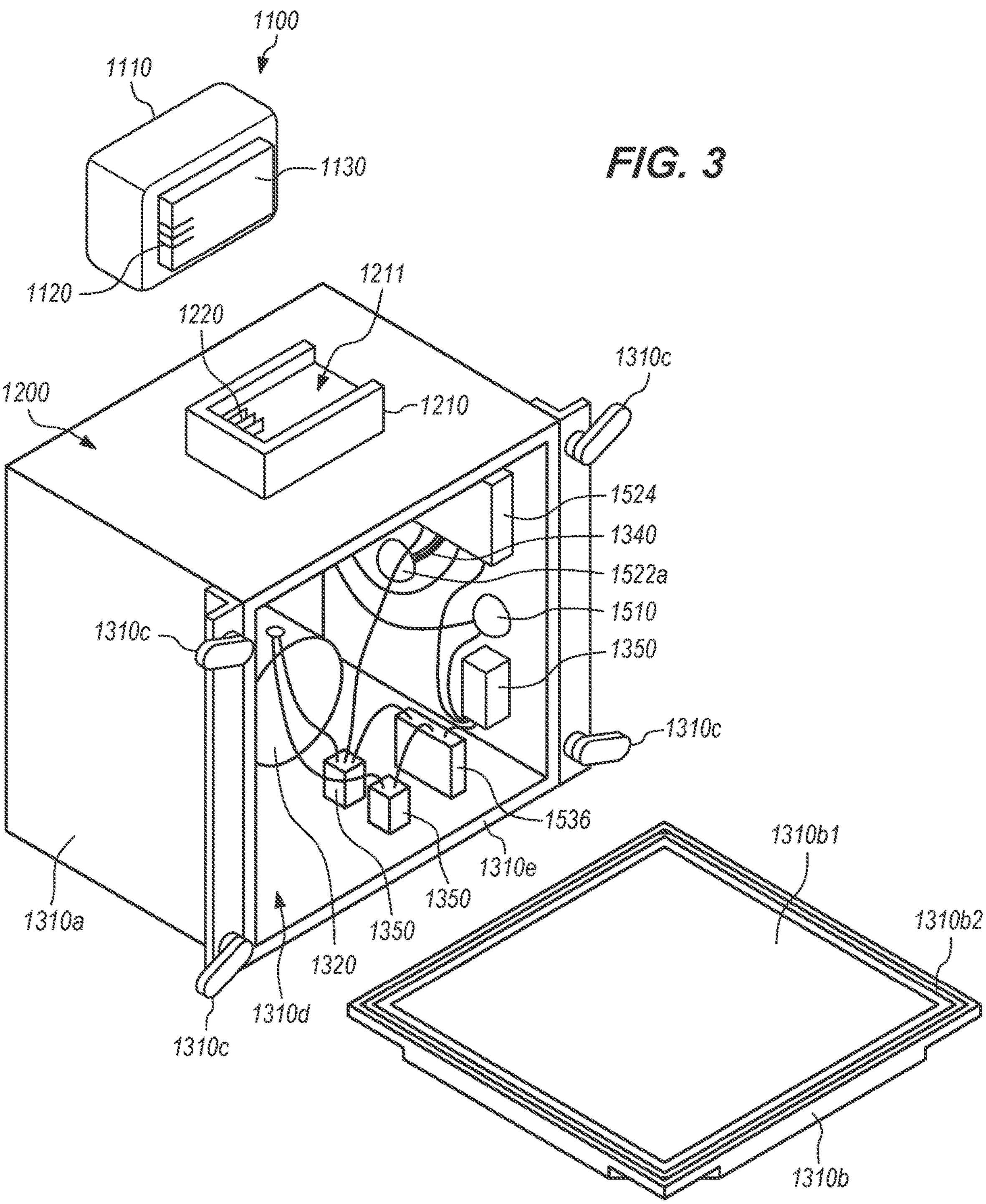
1420d
1370
1410
1420c
1420a
1420
1420b
1610
1420c
1400
1430a
1430c
1430b

FIG. 2

FIG. 3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1110
1130
1120
1211
1220
1200
1210
1310c
1524
1340
1522a
1510
1310c
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1350
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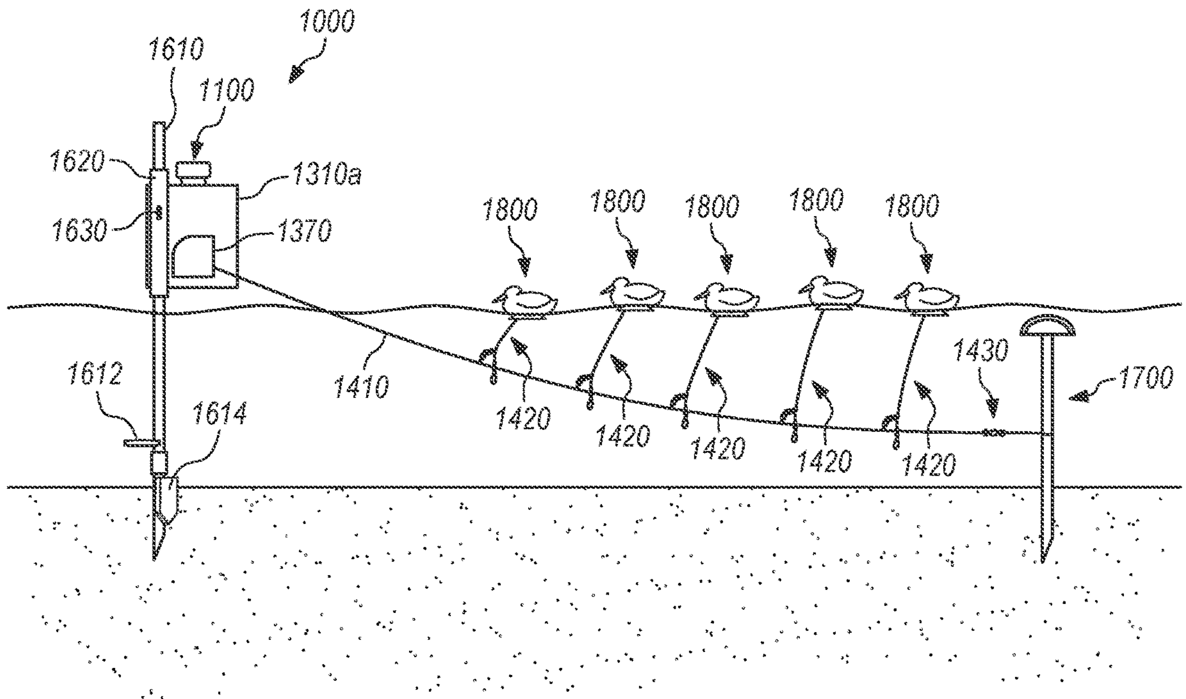
1310d
1310c
1310b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1610
1100
1620
1310a
1630
1370
1800
1800
1800
1800
1800
1410
1612
1614
1420
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1420
1420
1430
1700

FIG. 4

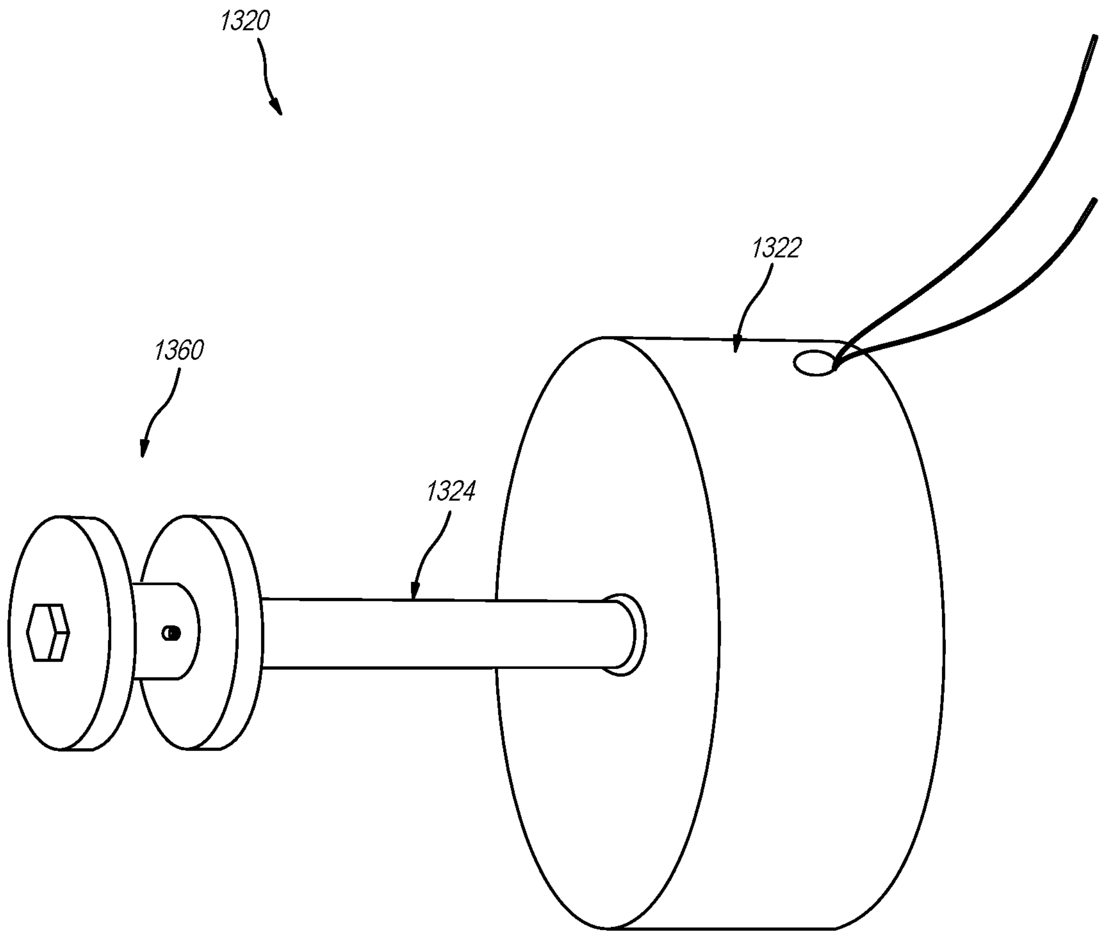
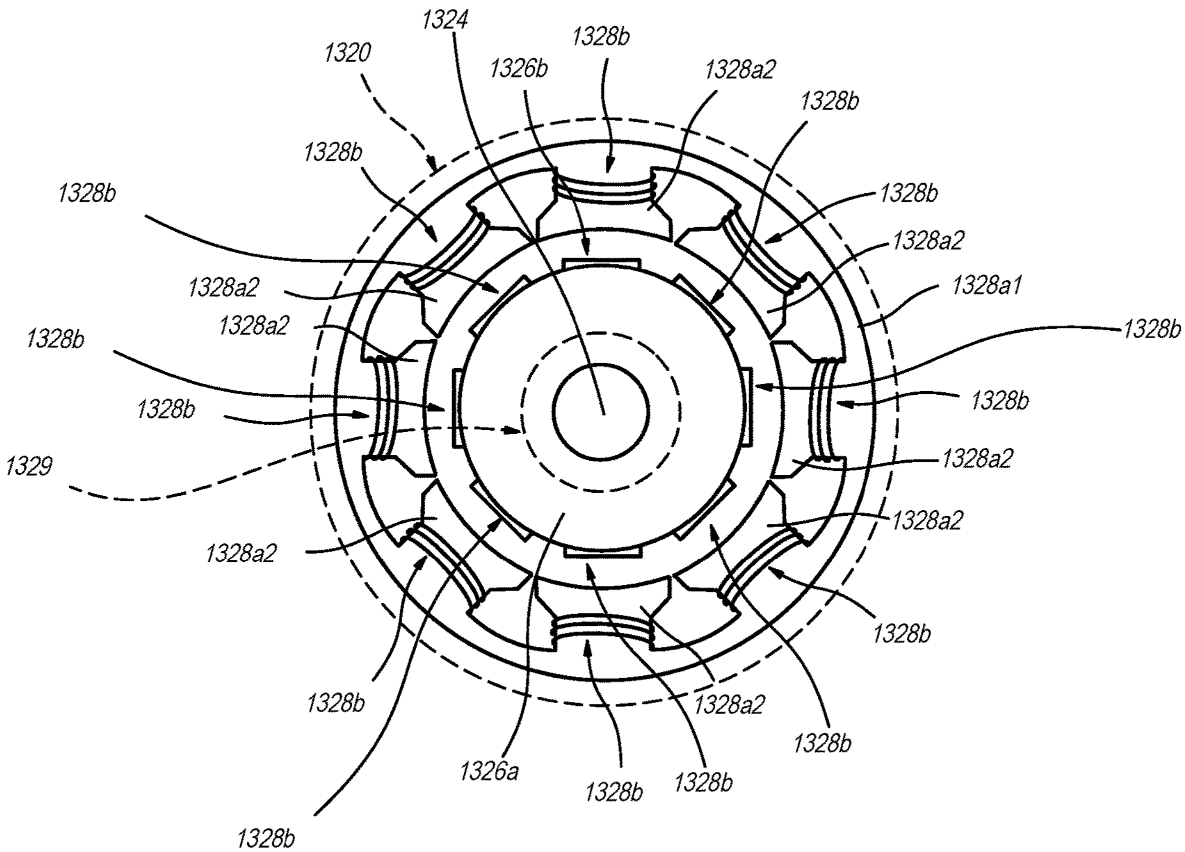


FIG. 5


1324
1328b
1320
1326b
1328a2
1328b
1328b
1328b
1328b
1328a2
1328a2
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1328b
1328b
1328b
1328b
1329
1328a2
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1328a2
1328b
1326a
1328b
1328b
1328b

FIG. 6

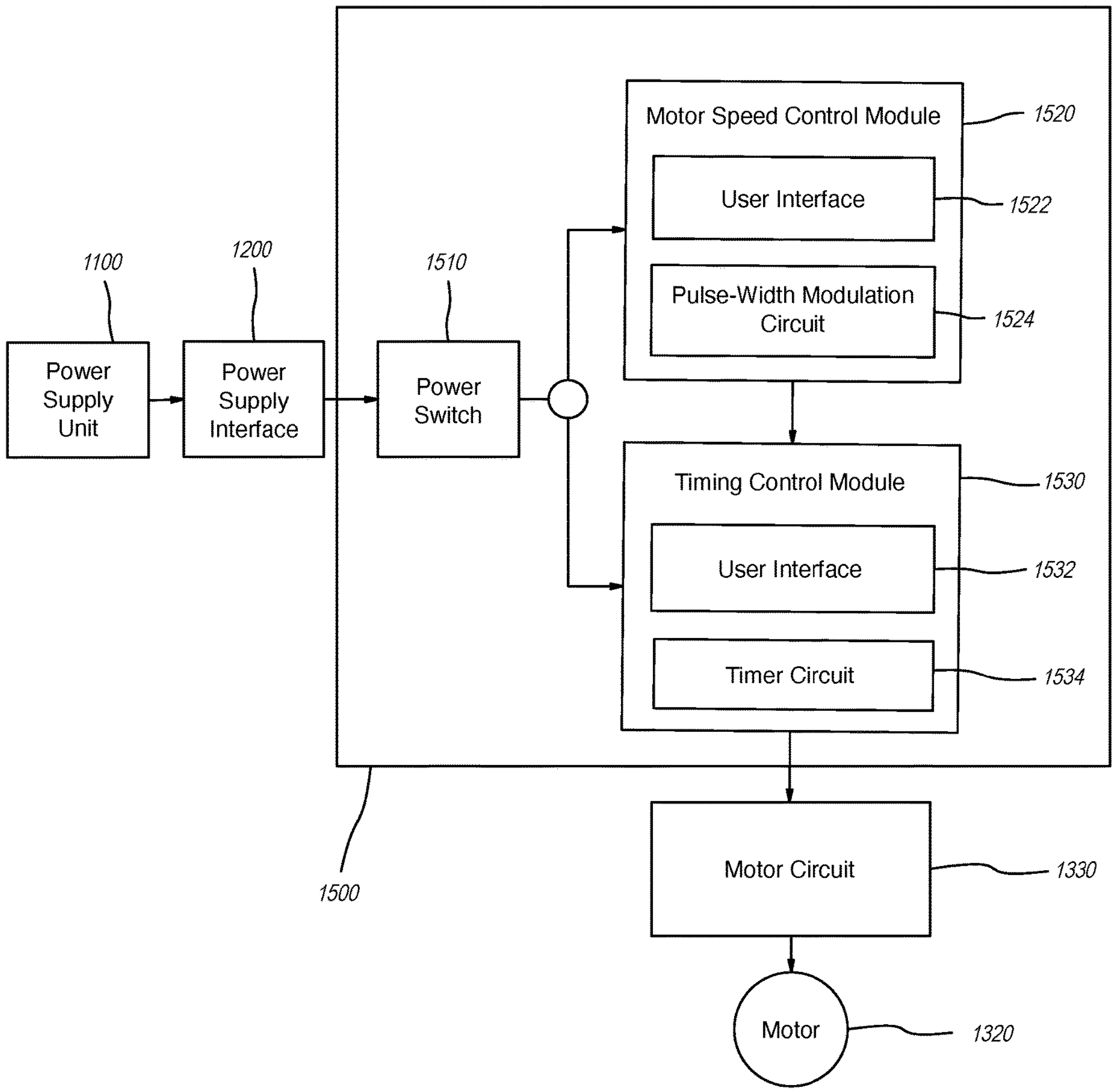
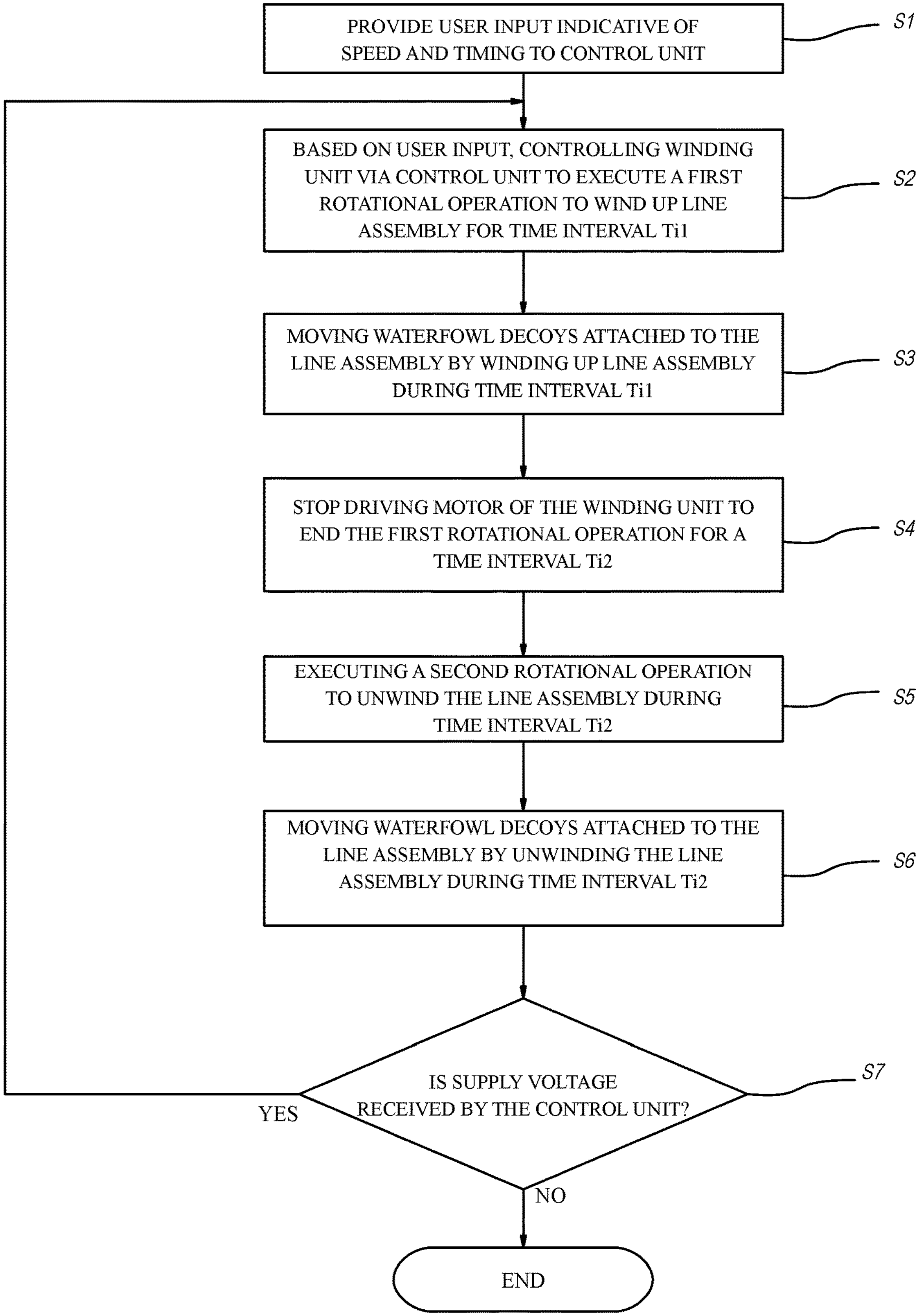

1100
Power Supply Unit
1200
Power Supply Interface
1510
Power Switch
Motor Speed Control Module
1520
User Interface
1522
Pulse-Width Modulation Circuit
1524
Timing Control Module
1530
User Interface
1532
Timer Circuit
1534
1500
Motor Circuit
1330
Motor
1320

FIG. 7

FIG. 8


PROVIDE USER INPUT INDICATIVE OF SPEED AND TIMING TO CONTROL UNIT
S1
BASED ON USER INPUT, CONTROLLING WINDING UNIT VIA CONTROL UNIT TO EXECUTE A FIRST ROTATIONAL OPERATION TO WIND UP LINE ASSEMBLY FOR TIME INTERVAL Ti1
S2
MOVING WATERFOWL DECOYS ATTACHED TO THE LINE ASSEMBLY BY WINDING UP LINE ASSEMBLY DURING TIME INTERVAL Ti1
S3
STOP DRIVING MOTOR OF THE WINDING UNIT TO END THE FIRST ROTATIONAL OPERATION FOR A TIME INTERVAL Ti2
S4
EXECUTING A SECOND ROTATIONAL OPERATION TO UNWIND THE LINE ASSEMBLY DURING TIME INTERVAL Ti2
S5
MOVING WATERFOWL DECOYS ATTACHED TO THE LINE ASSEMBLY BY UNWINDING THE LINE ASSEMBLY DURING TIME INTERVAL Ti2
S6
IS SUPPLY VOLTAGE RECEIVED BY THE CONTROL UNIT?
S7
YES
NO
END

WATERFOWL MOTION SIMULATION DEVICE

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority to U.S. Provisional Application No. 63/256,569 filed on Oct. 16, 2021, which is fully incorporated herein by reference.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

[0002] Not applicable.

BACKGROUND DISCUSSION

[0003] Waterfowl decoys are widely used in the sport of waterfowl hunting to attract waterfowl. Waterfowl hunting often takes place in a wetland or another type of aquatic terrain, wherein the waterfowl decoys are distributed to float atop water in such terrain. To enhance the realisticness of the waterfowl decoys, their motion can be affected to simulate that of waterfowl, producing natural effects within the water, such as ripples. As a conventional means of doing so, waterfowl decoys have been attached to a common line, which can be pulled by a hunter to affect the motion of the waterfowl decoys. The hunter's movement in pulling the line, however, risks alerting waterfowl in the vicinity to the hunter's location.

[0004] Various devices have been used in connection with such a line configuration to automate the pulling of the line, which often include a spool rotatable by a battery-powered motor via an output shaft. In many instances, the spool, motor, and batteries are sealed within a common housing having an opening through which the line is connected to the spool. An issue presented by such a configuration is that debris and water adhered to the line can enter the housing as the line is wound with respect to the spool, presenting a risk of obstructing the functionality of the components inside the housing or subjecting them to damage. Another issue presented by such a configuration is the difficulty of replacing the batteries during a hunt. For example, environmental factors, such as water and low temperature, can compromise the hunter's dexterity and cause ice to form on such devices, rendering it difficult and tedious to disassemble such devices to the extent necessary to replace the batteries. Further, the motors of such devices often include a gear drive to drive rotation of the output shaft, which, in operation, produces a noise that can deter waterfowl. The waterfowl motion simulation device of the present disclosure solves one or more of the issues set forth above.

SUMMARY

[0005] One aspect of the present invention is directed to a waterfowl motion simulation device that includes a winding unit controlled by a control unit to perform rotational operations to wind and unwind a line assembly connected to waterfowl decoys in an aquatic terrain. The winding unit includes a motor that is accommodated in a winding unit housing, and a winding implement that is rotatably supported outside the winding unit housing by an output shaft of the motor. A power supply unit is removably engaged with a power supply interface on an exterior surface of the winding unit housing, and is operable to supply a voltage to the control unit via the power supply interface. The control unit includes at least one user interface and is configured to control rotational operations of the winding unit by controlling the motor to rotate the winding implement according to user input indicative of rotational speed and timing received via the at least one user interface. The line assembly may include a main line having a plurality of decoy attachment appendages connected along its length and connectable to an anchor via an anchor appendage. Waterfowl decoys may be removably connected to the main line via the decoy attachment appendages such that their motion is affected in the aquatic terrain by winding and unwinding the line assembly with respect to the winding implement in response to rotational operations of the winding unit. Embodiments of this aspect may also include a mounting assembly configured to support at least in part the power supply unit, power supply unit, winding unit, and control unit above the aquatic terrain. The mounting assembly may include an adjustment sleeve connected to the exterior surface of the winding unit housing, and a main support structure configured to be slidably received by the adjustment sleeve. A locking mechanism may be operably associated with the adjustment sleeve to releasably lock the main support structure within the adjustment sleeve at a point along the length of the main support structure.

[0006] In another general aspect, the present invention is directed to a method of using the waterfowl motion simulation device to affect the motion of at least one waterfowl decoy in an aquatic terrain. The method includes positioning the waterfowl motion simulation device above the aquatic terrain at a distance from an anchor, connecting the main line of the line assembly to the anchor via the anchor appendage, and connecting the at least one waterfowl decoy to the main line via at least one of the plurality of decoy attachment appendages. The method also includes providing user input indicative of rotational speed and timing of rotational operations of the winding unit to the control unit via the at least one user interface, and outputting from the control unit to the motor a motor control signal based on the user input. The method also includes the motor, based on the motor control signal, applying torque to the winding implement in a first rotational direction for a first time interval to perform a first rotational operation of rotating the winding implement in the first rotational direction, and, by rotating the winding implement in the first rotational direction, winding the line assembly with respect to the winding implement to move the at least one waterfowl decoy in the aquatic terrain. The method also includes the motor, based on the motor control signal, stopping application of torque to the winding implement for a second time interval, upon expiration of the first time interval, to perform a second rotational operation of rotating the winding implement in a second rotational direction in response to torque applied to the winding implement by the line assembly, and, by rotating the winding implement in the second rotational direction, unwinding the line assembly with respect to the winding implement to move the at least one waterfowl decoy in the aquatic terrain. The method may also include repeating steps, after the expiration of the second time interval, to perform the rotational operations of the winding unit at least one more time.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] FIG. **1** is a perspective view showing the rear side of the waterfowl motion simulation device of an embodiment of the present invention, including a power switch, speed input device, and speed output device of the control unit.

[0008] FIG. **2** is a perspective view showing the waterfowl motion simulation device of an embodiment of the present invention with waterfowl decoys attached to the line assembly.

[0009] FIG. **3** is a perspective view showing the waterfowl motion simulation device of an embodiment of the present invention with the cover removed from the container of the winding unit housing and the power supply unit removed from the power supply interface.

[0010] FIG. **4** is a side view of the waterfowl motion simulation device of an embodiment of the present invention implemented in a body of water.

[0011] FIG. **6** is a side view showing the rotor, stator, and output shaft of the motor of the waterfowl motion simulation device of an embodiment of the present invention.

[0012] FIG. **7** is a schematic illustration of an exemplary embodiment of the power supply unit, the power supply interface, the control unit, the motor, and the motor circuit of the waterfowl motion simulation device of an embodiment of the present invention.

[0013] FIG. **8** is a flowchart of an exemplary method of using the waterfowl motion simulation device to move waterfowl decoys.

DETAILED DESCRIPTION

[0014] Embodiments of the present invention will be disclosed herein in detail with reference to FIGS. **1**, **2**, **3**, **4**, **5**, **6**, **7**, and **8**. For simplicity and clarity of illustration, elements indicated therein are not necessarily drawn to scale, and reference labels have been repeated thereamong to indicate analogous elements. Each embodiment is disclosed for the purpose of enabling a person of ordinary skill in the art to appreciate and understand the principles and practices of the present invention. It is to be understood, however, that all of such embodiments are merely examples and shall not be construed as limiting the scope of the present invention.

[0015] The present invention is directed generally to a waterfowl motion simulation device **1000**. The waterfowl motion simulation device **1000** functions to affect the motion of waterfowl decoys **1800** distributed in a body of water, such as a lake, pond, wetland, stream, canal, or river. Each waterfowl decoy **1800** may be embodied by a hull defining an inner cavity and shaped to imitate the periphery of a species of waterfowl, such as a duck, goose, or other aquatic bird. Each hull may be made of wood, a polymer (such as polyethylene or polyvinyl chloride), or any other material known in the art as suitable for forming a waterfowl decoy **1800** of sufficient buoyancy to remain substantially afloat in a body of water.

[0016] The waterfowl motion simulation device **1000** includes a power supply unit **1100**, a power supply interface **1200**, a winding unit **1300**, a line assembly **1400**, an anchor **1700**, and a control unit **1500**. In a preferred embodiment, the waterfowl motion simulation device **1000** may also include a mounting assembly **1600**.

[0017] The power supply unit **1100** of the waterfowl motion simulation device **1000** includes a power supply housing **1110**, a power supply **1120**, and a power supply circuit **1130**. The power supply housing **1110** accommodates the power supply **1120** and power supply circuit **1130**. The power supply housing **1110** is formed by a container made of a polymer, such as polyethylene, or other material resilient to the deteriorative effects of exposure to various atmospheric and environmental conditions, such as water or ultraviolet ray exposure. The power supply housing **1110** is configured to support the power supply **1120** and the power supply circuit **1130** on the power supply interface **1200**. The power supply housing **1110** includes a support portion **1130** configured to removably engage with a corresponding support portion **1211** of the power supply interface **1200**. In one embodiment, for example, the support portion **1130** of the power supply housing **1110** is formed by a rectangular shaped protrusion adapted to removably engaged with a U-shaped recess of the support portion **1211** of the power supply interface **1200**.

[0018] The power supply **1120** is configured to output a voltage to power constituent elements of the waterfowl motion simulation device **1000**, such as the winding unit **1300** and the control unit **1500** (said voltage may be referred to herein as the "supply voltage"). The power supply **1120**, for example, may be embodied by one or more battery cells, such as lead-acid, lithium-ion, nickel-cadmium, nickel metal hydride, or molten salt battery cells. In one embodiment, the power supply **1120** is embodied by lithium-ion battery cells that output a 20-volt direct current voltage, but battery cells with different compositions and voltage outputs may be implemented to facilitate operability with variations of the constituent elements of the waterfowl motion simulation device **1000**. The power supply **1120** is electrically connected to the power supply circuit **1130** to output the supply voltage to the power supply circuit **1130**.

[0019] The power supply circuit **1130** applies the supply voltage of the power supply **1120** to the control unit **1500** through the power supply interface **1200**. The power supply interface **1200** includes a power supply interface housing **1210** and a power supply interface circuit **1220** accommodated in the power supply interface housing **1210**. The power supply interface housing **1210** may be formed of a polymer separately from a winding unit housing **1310** to be described hereinafter or as a unitary part of the winding unit housing **1310**. The power supply interface housing **1210** includes a support portion **1211** adapted to removably engage with the support portion **1130** of the power supply housing **1110** and support the power supply unit **1100** on the exterior surface of the winding unit housing **1310**.

[0020] Each of the power supply circuit **1130** and the power supply interface circuit **1220** includes a terminal assembly. Each terminal assembly has terminals, including, for example, input terminals **1222** and output terminals **1120**. Output terminals **1120** of the power supply circuit **1130** may be electrically connected to input terminals **1222** of the power supply interface circuit **1220** to output the supply voltage from the power supply circuit **1130** to the power supply interface circuit **1220**. For example, output terminals **1120** of the power supply circuit **1130** may be embodied by terminal sockets, such as slots, holes or the like, that receive input terminals **1222** of the power supply interface circuit **1220** embodied by terminal blades, pins, loops or the like exposed through a surface of the support portion **1211** of the power supply interface housing **1210**.

[0021] Output terminals **1120** of the power supply interface circuit **1220** may be electrically connected to the control unit **1500** via wired communication link, such as insulated copper wires, to output the supply voltage to control modules **1520**, **1530** of the control unit **1500** to be described herein. As will also be more fully described herein, the control unit **1500** may be controlled to modulate the pulse width of the supply voltage based on user input and output a motor control signal to affect rotational operations of the winding unit **1300**.

[0022] The winding unit **1300** includes a motor **1320**, a motor circuit **1330**, a winding unit housing **1310**, a winding implement **1360**, and a winding implement cover **1370**. The winding unit housing **1310** is formed by a cover **1310***b* and a container **1310***a*, each of which are made of a polymer (such as polyethylene) or any other material resilient to the deteriorative effects of exposure to various atmospheric and environmental conditions, such as water and ultraviolet-ray exposure. The container **1310***a* has an opening defined by a rim. The cover **1310***b* may be connected to the rim of the container **1310***a* to define an inner cavity **1310***d* that accommodates the motor **1320** and control modules **1520**, **1530** of the control unit **1500**. The cover **1310***b* may be removably or hingedly connected to the rim of the container **1310***a* to facilitate access to the inner cavity **1310***d*. For example, a ledge may be formed around the periphery of, and slightly lower than, the rim, and a plurality of claw elements **1310***c* may be rotatably secured in surfaces of the ledge at corners thereof. When the interior surface **1310***b***2** of the cover **1310***b* is positioned over and in contact with the rim of the container **1310***a*, the claw elements **1310***c* may be rotated to securely fit over an exterior surface of the cover **1310***b*, thereby securing the cover **1310***b* to the container **1310***a*.

[0023] In a preferred embodiment, the cover **1310***b* may be adapted to sealingly engage with the rim of the container **1310***a* to impede liquid from entering the inner cavity **1310***d*, which may cause damage to constituent elements of the present invention accommodated therein. For example, a recess configured to receive the rim of the container **1310***a* may be formed in the interior surface **1310***b***2** of the cover **1310***b*. A collar **1310***b***3** configured to sealingly engage with the rim may be provided inside the recess. The collar **1310***b***3** may, for example, be embodied by a strip or tube of an elastomeric material, such as ethylene propylene diene monomer, with sufficient elasticity to sealingly conform to the rim in response to compressive stress occurring between the rim and the collar **1310***b***3**. Such compressive stress may occur, for example, when the rim is positioned inside the recess of the cover **1310***b* so as to be in contact with the collar **1310***b***3** and the claw elements **1310***c* are securely fitted over the exterior surface **1310***b***1** of the cover **1310***b* as previously described herein.

[0024] A circular aperture may be formed in a surface of the winding unit housing **1310** such that an output shaft **1324** of the motor **1320** to be described hereinafter may protrude from the winding unit housing **1310**. An elastomeric bushing may be provided within or around the circular aperture of the winding unit housing **1310** so as to closely fit around the outer peripheral surface of the output shaft **1324**, thereby facilitating the prevention of liquid from entering the inner cavity **1310***d* of the winding unit housing **1310**.

[0025] As noted, the winding unit housing **1310** accommodates the motor **1320**. For clarity, embodiments of the present invention will hereinafter be described based on an exemplary brushless direct current motor ("DC motor") with reference to FIGS. **5** and **6**, but the scope of the present invention is not limited to such embodiment of a brushless DC motor. Indeed, the motor **1320** may be constituted by any suitable electric motor, including, for example, a brushed, brushless, or coreless DC motor.

[0026] In general, the motor **1320** includes a motor body **1322**, an output shaft **1324**, a rotor **1326**, and a stator **1328**. The motor body **1322** defines an inner cavity and is formed of a metal, an alloy, a resin, or other suitable material. A circular aperture is formed in the center of a surface of one end of the motor body **1322** and extends in the axial direction to the inner cavity of the motor body **1322**.

[0027] Referring to FIG. **6**, the motor body **1322** accommodates the rotor **1326** and the stator **1328**. The rotor **1326** functions to rotate the output shaft **1324** based on magnetic interaction with the stator **1328**. The rotor **1326** may include a cylindrical core member **1326***c*, and a plurality of permanent magnets **1326***b* bonded to a peripheral surface of the core member **1326***c* at substantially equal distances apart in the circumferential direction. The core member **1326***c* of the rotor **1326** is operatively associated with the output shaft **1324** such that rotation of the rotor **1326** induces corresponding rotation of the output shaft **1324**. For example, an axial bore may be formed to extend through the center of the core member **1326***c* in an axial direction and securely fitted over the output shaft **1324** on or near a first end thereof. The second end of the output shaft **1324** protrudes from the motor body **1322** and the winding unit housing **1310** through the respective circular apertures formed therein. Rotatable support members **1329**, such as bearings, may be provided within the motor body **1322** to rotatably support the output shaft **1324**.

[0028] The stator **1328** facilitates rotation of the rotor **1326** by generating magnetic fields according to a driving voltage signal input from the motor circuit **1330**. As shown in FIG. **6**, The stator **1328** may include a stator housing **1328***a*, and windings **1328***b* that correspond to a plurality of phases of the motor **1320** (e.g., U, V, and W phases). The stator housing **1328***a* may be embodied, for example, by a stator yoke **1328***a***1** and a plurality of ferromagnetic field poles **1328***a***2** formed to protrude from the stator yoke **1328***a***1** in an inward diametrical direction. The field poles **1328***a***2** may be arranged at substantially equal distances apart in a circumferential direction. Each winding **1328***b* includes one or more electrically-conductive wires, such as copper wires. One or more winding(s) **1328***b* may be coiled around each armature to facilitate the generation of a magnetic field upon application of a voltage to the windings **1328***b*. The rotor **1326** may be positioned within a space defined by the field poles **1328***a***2** such that the magnetic fields generated by the windings **1328***b* of the stator **1328** and the permanent magnets **1326***b* of the rotor **1326** may interact to induce rotation of the rotor **1326** and output shaft **1324**.

[0029] For example, according to a driving voltage signal to be described hereinafter, magnetic fields may be generated sequentially through the windings **1328***b* in each phase of the motor **1320** to interact with the magnetic field(s) of the permanent magnet(s) of the rotor **1326** to induce rotation of the rotor **1326** and the output shaft **1324** in a first rotational direction, generating torque in the first rotational direction. For clarity, the present invention is described herein based on a motor driven in a first rotational direction, but the motor **1320** is not limited to being driven in the first rotational direction. Indeed, the direction of the current may be reversed via logic circuitry, such as an h-bridge circuit configuration, to drive the motor **1320** in a second rotational direction opposite the first rotational direction.

[0030] The winding implement **1360** functions to rotate in response to torque received from the motor **1320** and the line assembly **1400** to wind and unwind a length of the line assembly **1400**. For example, the winding implement **1360** may be embodied by a spool having a circular aperture formed in its center passing in an axial direction. The circular aperture may be securely fitted over the second end of the output shaft **1324** via any suitable connecting means, such as adhesives, mechanical fasteners, and/or couplings, to receive torque generated by the motor **1320**. Torque generated by the motor **1320** may thereby be applied to the winding implement **1360** via the output shaft **1324** to drive rotation of the winding implement **1360**.

[0031] The winding implement **1360** is typically substantially covered by the winding implement cover **1370** such that rotational operations of the winding implement **1360** are substantially concealed from the sight of waterfowl. The winding implement cover **1370** may be made of a polymer and removably attached to an exterior surface of the winding unit housing **1310** by mechanical fasteners or any other suitable means. An opening is formed in a front side surface of the winding implement cover **1370** so that the line assembly **1400** can be connected to the winding implement **1360**. The opening is also of sufficient size to generally allow any debris within the winding implement cover **1370** to be manually removed without detaching the winding implement cover **1370** from the winding unit housing **1310**.

[0032] The line assembly **1400** includes a main line **1410**, a plurality of decoy attachment appendages **1420**, and an anchor appendage **1430**. The main line **1410** is made of a material sufficiently flexible to be wound, arranged, or otherwise manipulated around the outer peripheral surface of the winding implement **1360** in a circumferential direction, such as string, nylon, polyvinylidene fluoride, polyethylene, or any sufficiently elastic polymer. Various portions of the main line **1410** may be manipulated or otherwise adapted to provide points at spaced apart intervals along the length of the main line **1410** at which the decoy attachment appendages **1420** can be connected. For example, as illustrated in FIG. **2**, various portions of the main line **1410** may form a loop or ring to which each decoy attachment appendage **1420** can be connected via a clip **1420***b*. In one embodiment, the length of the main line **1410** is 25 feet, but other lengths may be implemented to allow more or less waterfowl decoys **1800** to be attached and to facilitate use in various environments. The first end of the main line **1410** is inserted through the opening in the winding implement cover **1370** and secured to or within the surface of the winding implement **1360**, while the second end of the main line **1410** is attached to the anchor appendage **1430**.

[0033] The anchor appendage **1430** is configured to secure the second end of the main line **1410** to an anchor **1700**. The anchor appendage **1430** generally includes at least one mechanical connector, such as one or more clips, configured to removably connect the main line **1410** to the anchor **1700**. In some embodiments, the anchor appendage **1430** also includes an elastic line, such as an elastic cord, tube, band or the like, to elastically secure the main line **1410** to the anchor **1700** in conjunction with the at least one mechanical connector. The elasticity of the elastic line of the anchor appendage **1430** functions to create greater material displacement within the line assembly **1400** near the anchor **1700** which can facilitate greater motion of the waterfowl decoys **1800** during operations to be described herein. As shown in FIG. **2**, in one embodiment, the anchor appendage **1430** may be constituted by a swivel clip attached to the second end of the main line **1410**, an elastic line attached to the swivel clip, and a clip attached to the elastic line for connecting to the anchor **1700**.

[0034] The anchor **1700** may include any inanimate object configured to remain in a substantially fixed position as a tensile force occurs within the line assembly **1400** in response to a maximum torque applied to the winding implement **1360** by the motor **1320**. For example, the inanimate object of the anchor **1700** may be embodied by a natural inanimate object (or "natural anchor"), such as a tree, or, as shown in FIG. **4**, an artificial inanimate object (or "artificial anchor"), such as a stake.

[0035] In operation, the second end of the main line **1410** is anchored such that the main line **1410** remains sufficiently taut between the anchor **1700** and the winding implement **1360** to affect the motion of attached waterfowl decoys **1800** in response to being wound and unwound by the winding unit **1300** as described herein. Waterfowl decoys **1800** are attached to the main line **1410** via the decoy attachment appendages **1420**. Each decoy attachment appendage **1420** includes a line with a first end and a second end opposite the first end. The line of each decoy attachment appendage **1420** is formed of material sufficiently flexible to be arranged or manipulated into a knot or loop, such as string, nylon, polyvinylidene fluoride, or polyethylene.

[0036] A waterfowl decoy **1800** may be removably connected to the first end of the line of each decoy attachment appendage **1420**. For example, the first end of the line of each decoy attachment appendage **1420** may be directly tied or crimped to a waterfowl decoy **1800**. Alternatively, the first end of the line of each decoy attachment appendage **1420** may be connected to a waterfowl decoy **1800** indirectly via any other suitable means, such as a chemical bonding agent (such as an adhesive), or a mechanical connector (such as a fastener, bracket, clip, or the like).

[0037] The line of each decoy attachment appendage **1420** may also be removable connected to the main line **1410** of the line assembly **1400** via a clip, such as a swivel clip. For example, each clip may include an eye portion and a closable hook. The second end of the line of each decoy attachment appendage **1420** may be inserted through and slidably received by the eye portion of a respective clip. Weight elements **1420***c*, such as lead or cast iron egg weights, that each have a cross sectional area that exceeds the respective diameters of the eye portions of the clips may be connected respectively to the second end of the line of each decoy attachment appendage **1420**, for example, to prevent each line from exiting the eye portion of a respective clip. The closable hook of each clip may be hooked and closed around one of the portions of the main line **1410** of the line assembly **1400** that forms a point of connection for the decoy attachment appendage **1420** (e.g., a loop or ring). As an alternative, it is to be understood that the line of each decoy attachment appendage **1420** may be directly tied to the main line **1410** of the line assembly **1400** or indirectly connected to the main line **1410** by any suitable means known in the art, including, for example, chemical bonding agents (such as adhesives) or mechanical connectors (such as fasteners, brackets, other clips and the like).

[0038] The control unit **1500** controls the rotational operations of the winding unit **1300** according to user input. The control unit **1500** includes a power switch **1510**, a motor speed control module **1520**, and a timing control module **1530**. For clarity, the motor speed control module **1520** and the timing control module **1530** may herein be referred to collectively as the "control modules **1520**, **1530**" when unnecessary to distinguish therebetween.

[0039] The power switch **1510** may be interposed between the power supply interface **1200** and the control modules **1520**, **1530** to selectively set on or off the supply voltage input to the control modules **1520**, **1530** from the power supply interface **1200**. The power switch **1510** may be provided on the exterior surface of the winding unit housing **1310**.

[0040] The motor speed control module **1520** is operable to generate a PWM voltage signal to drive the motor **1320** at a rotational speed indicated by user input. The motor speed control module **1520** includes a user interface **1522**, a pulse width modulation circuit ("PWM circuit") **1526**, and a PWM circuit housing **1524**.

[0041] The user interface **1522** of the motor speed control module **1520** includes at least one speed input device **1522***a* to receive user input indicative of a desired rotational speed of the motor **1320**. Each speed input device **1522***a* may be embodied by a knob, dial, wheel, lever, button, touch-screen display, or any other device capable of receiving user input, which generally has indicia that signifies, for example, a rotational speed or a duty ratio. At least one speed input device **1522***a* may be provided such that it is accessible outside the winding unit housing **1310**. For example, as shown in FIG. **1**, at least one speed input device **1522***a* may be embodied by a dial rotatably embedded in the exterior surface of the winding unit housing **1310**. The user interface **1522** of the motor speed control module **1520** may also include one or more speed output devices **1522***b*, such as a display, speaker, or any other device capable of presenting output information that signifies, for example, a rotational speed or a duty ratio.

[0042] Based on user input indicative of a desired rotational speed received through a speed input device **1522***a*, the user interface **1522** may generate and output to the PWM circuit **1526** a motor speed instruction signal. The motor speed instruction signal has rotational speed information that indicates, for example, a target voltage sufficient to drive the motor **1320** at the desired rotational speed.

[0043] The user interface **1522** of the motor speed control module **1520** outputs the motor speed instruction signal to the PWM circuit **1526** via a communication link **1340**. The communication link **1340** may be constituted by any signal communication means suitable for communicating signals between the user interface **1522** and the PWM circuit **1526** of a particular configuration of the motor speed control module **1520**, which may include, for example, a wired or wireless communication link. As used herein, a wired communication link may include one or more electrically-conductive wires, serial cables, fiber optic cables, mesh cables, coaxial cables, or other forms of wired connections. In comparison, a wireless communication link, as used herein, may include radio, infrared, satellite, microwave, Internet, Bluetooth, Wi-Fi, Global System for Mobile Communications, General Packet Radio Service, Long Term Evolution, Cellular, or other forms of wireless connections. In one embodiment, for example, the user interface **1522** is in communication with the PWM circuit **1526** via insulated copper wires.

[0044] The PWM circuit **1526** may be mounted on a printed board accommodated in the PWM circuit housing **1524**. The PWM circuit **1526** is preferably constituted by any analog and/or digital logic circuitry (such as switches, comparators, clocks, gates, input terminals, output terminals, and the like) that functions to modulate a pulse width of a voltage according to the motor speed instruction signal. Alternatively, the PWM circuit **1526** may be constituted by a controller. The controller may include hardware resources for storing and executing software instructions, including, for example, a processing unit, such as a central processing unit ("CPU") or microprocessing unit ("MPU"), a memory device, such as a random access memory ("RAM") and/or read-only memory ("ROM"), input terminals, output terminals, and a plurality of peripherals (such as transistors and the like). Software instructions to determine a PWM voltage signal based on the motor speed instruction signal may be stored in the memory device and referenced by the processing unit to execute the outputting of the PWM voltage signal.

[0045] The PWM circuit **1526** may generate the PWM voltage signal based on a duty ratio calculated from the motor speed instruction signal. For example, the PWM circuit **1526** may calculate a duty ratio (50%) by recognizing a target voltage (e.g., 10 volts) indicated by the motor speed instruction signal and comparing such target voltage to the supply voltage (e.g., 20 volts) using one or more comparator (s). The PWM circuit **1526** may modulate the pulse width of the supply voltage according to the duty ratio and output a pulse-width-modulated voltage as the PWM voltage signal to the timing control module **1530**.

[0046] The timing control module **1530** functions to output a motor control signal to control the timing and rotational speed of rotational operations of the winding unit **1300**. The timing control module **1530** includes a user interface **1532**, a timer circuit **1534**, and a timer circuit housing **1536**.

[0047] The user interface **1532** of the timing control module **1530** includes one or more time value input devices **1532***a* to receive user input indicative of the desired timing of rotational operations. Each time value input device **1532***a* may be embodied by a knob, dial, wheel, lever, button, touch-screen display, or any other device capable of receiving user input, which generally has indicia that signifies, for example, a trigger signal and/or a time value. The user interface **1532** of the timing control module **1530** may also include one or more time value output devices **1532***b*, such as a display, speaker, or any other device capable of presenting output information that signifies, for example, a time value.

[0048] Based on user input indicative of timing received through the time value input device(s) **1532***a*, the user interface **1532** of the timing control module **1530** generates a timing instruction signal. The timing instruction signal may indicate, for example, one or more threshold time value(s) Tth**1**, Tth**2** that correspond(s) to the ending(s) of one or more time interval(s). The user interface **1532** of the timing control module **1530** may output the timing instruction signal to the timer circuit **1534** through a communication link **1342**, such as Wi-Fi. Although the user interface **1532** of the timing control module **1530** is, for clarity, described herein as formed separately from the user interface **1532** of the motor speed control module **1520**, it is contemplated that both of said user interfaces **1522** and **1532** may be integrated to form a unitary user interface device, such as a microcomputer having a graphical user interface display of user-selectable indicia that signifies, for example, a duty ratio and one or more time value(s).

[0049] The timer circuit **1534** of the timing control module **1530** is operable to convert the voltage of the PWM voltage signal to an inconstant voltage and output it as the motor control signal according to the timing instruction signal. The motor control signal has rotational speed and timing information that indicates, for example, a voltage of the PWM voltage signal and output timing according to the timing instruction signal.

[0050] The timer circuit **1534** may be mounted on a printed board accommodated in the timer circuit housing **1536**. The timer circuit **1534** may be embodied by a controller, such as a programmable logic controller or programmable logic relay. The controller of the timing control module **1530** may include hardware resources for storing and executing software instructions, including, for example, a processing unit, such as a CPU, a memory device, such as RAM and/or ROM, input terminals, output terminals, and a plurality of peripherals (such as timers, comparators, clocks and the like). The memory device may store software instructions to determine a motor control signal based on the timing instruction signal and the PWM voltage signal. The processing unit may reference the software instructions to execute the outputting of the motor control signal.

[0051] The peripherals of the controller may include a timer, internal clock, and one or more switching devices in communication with the processing unit. The timer may obtain a time value T by counting an internal clock of the controller. Based on the software instructions, the processing unit compares, for example, the time value T to at least one threshold time value Tth**1**, Tth**2** indicated by the user input set in the timing instruction signal. Upon such comparison, if the time value T equals or exceeds the threshold time value Tth, the processing unit opens or closes the switching device(s) according to the software instructions. The switching device(s) may be interposed between at least one input terminal and output terminal of the controller such that the outputting of the motor control signal is started and stopped by such closing and opening of the switching device(s).

[0052] As an alternative to the controller described above, it is contemplated that the timer circuit **1534** may be embodied by any other analog and/or digital logic circuitry configured to generate and output a motor control signal according to the timing instruction signal and the PWM voltage signal.

[0053] The motor circuit **1330** of the winding unit **1300** is electrically connected to output terminal(s) of the timing control module **1530** to receive the motor control signal. The motor circuit **1330** functions to drive the motor **1320** to perform rotational operations according to the motor control signal. In particular, the motor circuit **1330** generates a driving voltage signal based on the motor control signal and outputs the driving voltage signal to windings **1328***b* that corresponds to at least one phase of the motor **1320**. For example, the motor circuit **1330** may include an inverter with switching devices, such as field effect transistors, connected in a multi-phase bridge configuration. The switching device(s) open and close in a predetermined sequence to convert a direct current voltage of the motor control signal into a multi-phase voltage and output the multi-phase voltage as the driving voltage signal to windings **1328***b* that correspond to at least one phase of the motor **1320**. By so doing, sufficient magnetic flux is generated through the windings **1328***b* and field poles **1328***a***2** of the stator **1328** to rotate the rotor **1326** and output shaft **1324** in the first rotational direction. It is contemplated that the motor circuit **1330** may alternatively be implemented by any other analog and/or digital circuitry operable to generate and output such a driving voltage signal based on the motor control signal.

[0054] As noted, such rotation of the rotor **1326** and output shaft **1324** generates torque in the first rotational direction, and the torque is applied to the winding implement **1360** via the output shaft **1324**. In response, the winding implement **1360** performs a rotational operation by rotating in the first rotational direction, from an initial angular position to a second angular position, at the desired rotational speed. During this rotational operation, a length of the main line **1410** of the line assembly **1400** winds around the outer peripheral surface of the winding implement **1360** in a circumferential direction. By so doing, the main line **1410** is moved so as to induce movement of waterfowl decoys **1800** attached thereto. In addition, tensile force occurring within the line assembly **1400** increases as the winding implement **1360** rotates to its second angular position, causing increasingly greater torque to be applied to the winding implement **1360** in a second rotational direction opposite the first rotational direction. Unless the driving voltage signal is otherwise stopped, the motor **1320** preferably continues to drive rotation of the winding implement **1360** in the first rotational direction until the winding implement **1360** obtains its second angular position, wherein the torque applied to the winding implement **1360** by the motor **1320** may be substantially equal to the torque applied to the winding implement **1360** by the line assembly **1400**.

[0055] When the driving voltage signal stops, the motor **1320** stops generating torque in the first direction owing to a lack of sufficient magnetic interaction between the permanent magnets **1326***b* of the rotor **1326** and the windings **1328***b* of the stator **1328**. Consequently, in response to the torque applied by the line assembly **1400**, the rotor **1326**, output shaft **1324**, and winding implement **1360** rotate in the second rotational direction until the winding implement **1360** has substantially reverted to its initial angular position, thereby unwinding a length of the main line **1410** from around the outer peripheral surface of the winding implement **1360**. This unwinding of the main line **1410**, likewise, functions to move the waterfowl decoys **1800** attached to the main line **1410**. The mounting assembly **1600** is configured to support the power supply unit **1100**, the power supply interface **1200**, the winding unit **1300**, and parts of the control unit **1500** at a predetermined distance above a body of water.

[0056] FIGS. **1**-**4** illustrate the waterfowl motion simulation device **1000** equipped with an exemplary mounting assembly **1600**. As shown in FIGS. **1**-**4**, the mounting assembly **1600** generally may include a main support structure **1610**, an adjustment sleeve **1620**, and a locking mechanism **1630**. The main support structure **1610** may be embodied by at least one shaft, pole, rod, or the like made of a sufficiently sturdy material, such as stainless steel, to support the weight of the power supply unit **1100**, the power supply interface **1200**, the winding unit **1300**, and parts of the control unit **1500**. The main support structure **1610** may include numerous shafts, poles, rods, or the like configured to be removably connected end-to-end so as to constitute lower, middle, and upper sections respectively of a single, longer shaft, pole, rod or the like. In one embodiment, the length of the main support structure **1610** is approximately **48** inches, but other lengths may be implemented to support the winding unit **1300** at higher or lower distances and to suit characteristics of the environment in which the present invention is practiced, such as water depth.

[0057] The main support structure **1610** may have a lower end and an upper end opposite the lower end. As shown in FIG. **4**, in one embodiment, the lower end of the main support structure **1610** may be formed to a point or edge to facilitate the insertion of the main support structure **1610** into a ground surface beneath the aquatic environment. In such an embodiment, a peg element **1614** protrudes from the main support structure **1610** in a direction substantially perpendicular to the longitudinal axis of the main support structure **1610**. The user may apply a downward force upon the peg element **1614** to further facilitate the insertion of the main support structure **1610** into the ground surface. Additionally, such an embodiment preferably includes a plate element **1612** connected to the main support structure **1610** near the lower end of the main support structure **1610** and beneath the peg element **1614**. The plate element **1612** functions to facilitate stability of the main support structure **1610** while inserted in the ground surface. For example, the plate element **1612** may embody a flat plate with a surface area greater in width than that of the main support structure **1610** to increase resistivity to tilting and rotation while inserted in the ground surface.

[0058] The adjustment sleeve **1620** is connected to an exterior surface of the winding unit housing **1310** via any suitable means, including, for example, chemical bonding agents (such as adhesives), mechanical connectors (such as bolts, screws, brackets and the like), or thermal bonding (such as melting) with or without a separate bonding agent (such as a polymer with a low melting point). The adjustment sleeve **1620** is configured to slidably receive the main support structure **1610**. For example, the adjustment sleeve **1620** may be embodied by a tube that defines a passage shaped to slidably fit over the outer peripheral surface of the main support structure **1610**.

[0059] The locking mechanism **1630** is operably associated with the adjustment sleeve **1620** to releasably lock the main support structure **1610** within the passage of the adjustment sleeve **1620** at a point along the length of the main support structure **1610**. For example, the locking mechanism **1630** may be embodied by a cylindrical shaft with opposing first and second ends, and a grip element connected to the first end of the shaft. External threads, for example, may be formed on a surface of the shaft of the locking mechanism **1630**, beginning at the second end of the shaft and extending a distance along the length of the shaft toward the first end of the shaft. A bore with internal threads may, for example, be formed in the adjustment sleeve **1620** to engage with the external threads on the shaft of the locking mechanism **1630**. The grip element may be embodied by a handle or multi-sided structure adapted to be gripped by a user's hand or a fastening tool, such as a wrench. When the main support structure **1610** occupies the passage of the adjustment sleeve **1620**, the locking mechanism **1630** may be adjusted so as to advance within the bore and into the outer peripheral surface of the main support structure **1610**. In a preferred embodiment, holes, groves, notches or the like may be machined in the outer peripheral surface of the main support structure **1610** at spaced apart intervals along its length for detent. Alternatively, it is contemplated that the locking mechanism **1630** may be embodied by any other means recognized in the art as associable with the adjustment sleeve **1620** to releasably lock the main support structure **1610** within the adjustment sleeve **1620** at a point along the length of the main support structure **1610**.

[0060] Although the mounting assembly **1600** has been described herein with respect to the exemplary mounting assembly **1600** of FIGS. **1-4**, it is not to be construed as limited to such exemplary mounting assembly **1600**. Indeed, in alternative embodiments, various support appendages may be operatively associated with the main support structure **1610** to secure the main support structure **1610** to objects, such as a tree or a boat. For example, in one alternative embodiment, a tree support appendage may be removably connected to the lower end of the main support structure **1610**. The tree support appendage may include, for example, a mounting bracket and a pointed screw that is connected to and protrudes outwardly from a back side of the mounting bracket. The main support structure **1610** may be pivotally supported within the mounting bracket. The main support structure **1610** may pivot from a position in which its longitudinal axis is substantially parallel to the screw (a "collapsed position") to a position in which its longitudinal axis is substantially perpendicular to the screw (an "upright position"). Apertures may be machined in the mounting bracket and the lower end of the main support structure **1610** such that the apertures of the mounting bracket and the lower end of the main support structure **1610** align when the main support structure **1610** is in the upright position. A pin may be inserted through the aligned apertures to fix the main support structure **1610** in the upright position. The screw may be advanced within a tree to support the waterfowl motion simulation device **1000** on the side of the tree.

[0061] In a second alternative embodiment, a ledge support appendage may be connected to the lower end of the main support structure **1610**. The ledge support appendage may include an L-shaped support member, and a hook member. The L-shaped support structure has a lower portion and an upper portion that bends and extends in an upward direction perpendicular to the lower portion. The main support structure **1610** protrudes upwardly from the lower portion of the L-shaped support member, and the hook member is connected to the upper portion of the L-shaped support member. The hook member includes a hook portion and a sleeve portion. The sleeve portion may define an inner cavity, and the upper portion of the L-shaped support member may be pivotally connected within the sleeve portion of the hook member such that the hook portion faces outwardly and downward in relation to the main support structure **1610**. The inner cavity of the sleeve portion may widen in direct proportion with distance from the point of pivotal connection to facilitate the pivoting of the L-shaped support member within the sleeve portion. The hook portion may be fitted over a ledge, such as a ledge formed by a hull of a boat, to support the waterfowl motion simulation device **1000** on the ledge. A pin may be inserted through apertures formed in the sleeve portion of the hook member and in the L-shaped support member to support the L-shaped support member at various angles relative to the ledge.

[0062] The waterfowl motion simulation device **1000** may be provided as a kit of parts, the kit of parts including: (i) the line assembly **1400** for connecting to waterfowl decoys **1800**; (ii) the winding unit **1300** for winding and unwinding the line assembly **1400** from one end of the line assembly **1400**; (iii) an artificial anchor for securing an opposite end of the line assembly **1400** at a distance apart from the winding unit **1300**; (iv) the control unit **1500** for controlling the winding and unwinding of the line assembly **1400** by controlling the winding unit **1300**; and (v) a power supply unit **1100** for powering the control unit **1500** and the winding unit **1300**. In a preferred embodiment, the kit of parts also includes a mounting assembly **1600** (such as a land mounting assembly **1600**) for supporting the winding unit **1300**, the power supply unit **1100**, and the control modules **1520**, **1530** above a body of water. The control modules **1520**, **1530** may be installed inside the winding unit housing **1310** during manufacture, and, in a preferred embodiment, the adjustment sleeve **1620** may be installed on the exterior surface of the winding unit housing **1310** during manufacture. According to one method, the waterfowl motion simulation device **1000** may be assembled from the kit of parts by mounting the winding unit **1300** and control modules **1520**, **1530** at a desired distance above the body of water using the mounting assembly **1600**. The main line **1410** of the line assembly **1400** may be inserted through the opening of the winding implement cover **1370** and connected to or within the outer peripheral surface of the winding implement **1360**. One end of the anchor appendage **1430** may be connected to the artificial anchor and the opposite end of the anchor appendage **1430** may be connected to the main line **1410**. The artificial anchor may be secured in a ground surface at a distance apart from the winding unit **1300** such that the line assembly **1400** is sufficiently taut between the anchor and the winding unit **1300** to allow a length of the main line **1410** to be wound and unwound by the winding unit **1300** and to move in response thereto. Waterfowl decoys **1800** may be connected to the line assembly **1400** via the decoy attachment appendages **1420** of the line assembly **1400** and then distributed in the body of water. The power supply unit **1100** may be operably engaged with the power supply interface **1200** to power the control unit **1500**. A user may then provide user input to the control unit **1500** via the user interface(s) of the control modules **1520**, **1530** to control the winding unit **1300** to execute rotational operations to wind and unwind the line assembly **1400**, thereby affecting movement of the waterfowl decoys **1800** in the body of water.

[0063] Rotational operations according to an embodiment of the waterfowl motion simulation device **1000** will be described hereinafter with reference to FIG. **8**. In general, the waterfowl motion simulation device **1000** executes rotational operations to affect movement of waterfowl decoys **1800** attached to the line assembly **1400** and distributed in a body of water. In describing said rotational operations, it is to be understood that software instructions appropriate to execute such rotational operations are prestored in one or more memory device(s) of the control unit **1500**. It is also to be understood that the torque applied to the winding implement **1360** by the motor **1320** is sufficiently greater than that applied to the winding implement **1360** by the line assembly **1400** to rotate the winding implement **1360** in a first rotational direction from an initial angular position to a second angular position.

[0064] In step S**1**, the user provides user input indicative of a desired rotational speed of the motor **1320** and timing of rotational operations to the control unit **1500** via the user interface(s) of the control modules **1520**, **1530**. For example, the user may manipulate a speed input device **1522***a* of the user interface **1522** of the motor speed control module **1520** to input information of the desired rotational speed of the motor **1320** into the motor speed control module **1520**. The user may manipulate a time value input device **1532***a* of the user interface of the timing control module **1530** to input information of the desired timing of rotational operations into the timing control module **1530**.

[0065] Upon receiving the user input, the control unit **1500** sets information of the desired rotational speed of the motor **1320** and timing of rotational operations included in the user input. For example, based on the user input received through the speed input device **1522***a*, the user interface of the motor speed control module **1520** may set a motor speed instruction signal containing information indicative of the desired rotational speed of the motor **1320** (e.g., a target voltage sufficient to drive the motor **1320** at the desired rotational speed). Similarly, based on the user input received through the time value input device **1532***a*, the user interface of the timing control module **1530** may set a timing instruction signal containing information indicative of the desired timing of rotational operations (e.g., time values indicative of time intervals during which to execute and/or delay executing rotational operations). For brevity, the motor speed instruction signal and the timing instruction signal may collectively be referred to herein as the "instruction signals" when unnecessary to distinguish therebetween. Once the instruction signals are set, the motor speed instruction signal is output to the PWM circuit **1526**, and the timing instruction signal is output to the timer circuit **1534**. The instruction signals may be retained by the control unit **1500** such that user input does not need to be provided on each subsequent occasion that the waterfowl motion simulation device **1000** is practiced.

[0066] In steps S**2** and S**3**, the control unit **1500** controls the winding unit **1300** to move the waterfowl decoys **1800** by executing a first rotational operation to wind the line assembly **1400** around the winding implement **1360** according to the rotational speed indicated by the user input for a predetermined time interval Ti**1**.

[0067] In particular, the control unit **1500** outputs to the winding unit **1300** a motor control signal that has a voltage sufficient to drive the motor **1320** of the winding unit **1300** at the desired rotational speed. To do so, the control unit **1500** generates a PWM voltage signal that has a voltage indicating the desired rotational speed of the motor **1320**. For example, based on the supply voltage and the motor speed instruction signal, the motor speed control module **1520** determines and sets a duty ratio of the PWM voltage signal by recognizing a target voltage indicated by the motor speed instruction signal and comparing the target voltage to the supply voltage. The motor speed control module **1520** then generates the PWM voltage signal according to the duty ratio by modulating the pulse width of the supply voltage. The PWM voltage signal is thereafter output to and received by the timing control module **1530** of the control unit **1500**.

[0068] The timing control module **1530** converts the voltage of the PWM voltage signal to an inconstant voltage and outputs it as the motor control signal during the first predetermined time interval Ti**1** indicated by the timing instruction signal. For example, a controller of the timing control module **1530** references software instructions that indicate timing information of the timing instruction signal to determine the duration of the time interval. According to the software instructions, the controller controls switching device(s), for example, to energize the output terminal(s) with the voltage of the PWM voltage signal during the time interval. The motor control signal is thereby output from the control unit **1500** to the winding unit **1300** via the output terminal(s).

[0069] The control unit **1500**, in particular, outputs the motor control signal to the motor circuit **1330** of the winding unit **1300**. Based on the motor control signal, the motor circuit **1330** outputs a driving voltage signal to drive the motor **1320** to rotate in the first rotational direction. For example, an inverter of the motor circuit **1330** may convert the motor control signal to a multi-phase voltage and output it as the driving voltage signal to windings **1328***b* of the motor **1320** sequentially according to a predetermined timing. According to the driving voltage signal, the windings **1328***b* within the various phases of the motor **1320** are energized to generate magnetic fields of sufficient magnetic flux in an order that interacts with the magnetic fields of the permanent magnets **1326***b* of the rotor **1326** to induce rotation of the rotor **1326** and output shaft **1324** in the first rotational direction at the desired rotational speed, thereby generating torque in the first rotational direction.

[0070] The torque generated by the motor **1320** is applied to the winding implement **1360** through the output shaft **1324** to drive rotation of the winding implement **1360** in the first rotational direction at the desired rotational speed. The winding implement **1360** is rotated in the first rotational direction, from its initial angular position to a second angular position, to wind a length of the main line **1410** of the line assembly **1400** around the outer peripheral surface of the winding implement **1360** in a circumferential direction. In response, the main line **1410** tautens and is pulled toward the winding implement **1360**, causing the waterfowl decoys **1800** attached to the line assembly **1400** to move responsively in a body of water. In addition, as the main line **1410** winds around the winding implement **1360** as described, a tensile force occurs within the line assembly **1400** owing to the force of the anchor **1700** acting on the line assembly **1400** in a direction biased to that of the force of the winding unit **1300** acting on the line assembly **1400**. This tensile force gradually increases as more of the line assembly **1400** is wound around the winding implement **1360** and increasingly applies torque to the winding implement **1360** in the second rotational direction until the winding implement **1360** obtains its second angular position. The winding implement **1360** preferably obtains its second angular position when the torque applied to the winding implement **1360** by the motor **1320** is substantially equal to the torque applied to the winding implement **1360** as a result of the tensile force occurring within line assembly **1400**.

[0071] In executing steps S**4**, S**5**, and S**6**, after the first rotational operation, the control unit **1500** controls the winding unit **1300** to move waterfowl decoys **1800** by executing a second rotational operation to unwind the line assembly **1400** from around the winding implement **1360**. In particular, the control unit **1500** stops the outputting of the motor control signal to the motor circuit **1330** of the winding unit **1300** to complete S**4**, which causes the motor **1320** to stop applying torque to the winding implement **1360** in the first rotational direction (owing to a lack of sufficient magnetic interaction between the rotor **1326** and stator **1328**). In response to the torque applied by the tensile force occurring in the line assembly **1400**, the winding implement **1360** rotates in the second rotational direction, from its second angular position to substantially its initial angular position, to execute the second rotational operation of step S**5**, unwinding a length of the line assembly **1400** from around its outer peripheral surface. As a result, the main line **1410** is untensed and retracts away from the winding unit **1300**, causing the waterfowl decoys **1800** attached to the main line **1410** to move responsively in a body of water and completing step S**6**.

[0072] In step S**7**, unless deactivated (i.e., the supply voltage is no longer supplied to the control unit **1500**), the control unit **1500** may control the winding unit **1300** to repeat steps S**2** through S**6** according to the timing indicated by the user input.

[0073] For example, according to one embodiment, the control unit **1500** may control the winding unit **1300** to repeat steps S**2** through S**6** during recurrent spaced-apart time intervals indicated by user input set in the timing instruction signal. In such embodiment, according to the timing instruction signal and prestored software instructions, the timing control module **1530** may output the motor control signal to the motor circuit **1330** during the recurrent spaced-apart time intervals. For example, the processing unit of the controller of the timing control module **1530** may start a timer to obtain a time value T by counting an internal clock of the controller, and the processing unit compares the time value T to a first threshold time value Tth**1**, such as 300 s, indicated by the timing instruction signal as the end of a time interval Ti**2**. The processing unit may repeat this comparison in regular time intervals of shorter duration, such as 0.10 s intervals, until the time value T is equal to or exceeds the first threshold time value Tth**1**. Upon the processing unit recognizing a time value T equal to or exceeding the first threshold time value Tth**1**, the processing unit closes one or more switching device(s) interposed between the input terminals and output terminals of the controller, thereby outputting the motor control signal to the motor circuit **1330**. Substantially simultaneously, the processing unit may stop, reset, and restart the timer to recommence obtaining time value T by counting the internal clock. The processing unit compares the time value T to a second threshold time value Tth**2**, such as 2.5 s, indicated by the timing instruction signal as the end of a time interval Ti**2** and may repeat this comparison in regular time intervals of shorter duration until the time value T is equal to or exceeds the second threshold time value Tth**2**. Upon the processing unit recognizing a time value T equal to or exceeding the second threshold time value Tth**2**, the processing unit may stop, reset, and restart the timer, and open the switching device(s) to stop outputting the motor control signal to the motor circuit **1330**. The timing control module **1530** then repeats steps S**2** through S**6** until deactivated.

[0074] The principles, preferred embodiment, and mode of operation of the present invention have been described in this specification. All references cited in this specification are hereby incorporated by reference insofar as there is no inconsistency with the disclosure of this specification. In interpreting this specification, all of the terms used to describe the present invention should be given the broadest interpretation consistent with the context. For example, the terms "comprises," "comprising," "includes," "including," and "having," are inclusive and therefore specify the presence of stated features, integers, steps, elements, operations, and/or components, but do not preclude the presence or absence of other features, integers, steps, elements, operations, components, and/or groups thereof. The conjunctive term "and/or," or terms of similar import, shall be understood to be inclusive of any and all combinations of the items listed in connection with such term. Ordinal numbers, such as "first," "second," and "third," are used to distinguish between various constituent elements for convenience and do not denote the order of constituent elements so distinguished. Further, directional terms, such as "top," "bottom," "upper," "lower," "left," "right," "upward," and "downward," are used to clarify and describe the relationship between various constituent elements of specific embodiments of the present invention, but do not denote absolute orientation. Therefore, such terms vary according to the orientation of the present invention. In addition to the foregoing terminological considerations, specific embodiments referenced in describing the present invention are not to be regarded as exhaustive or as limiting to the full scope of the present invention. Other persons may modify the disclosed embodiments, or employ equivalents thereof, without departing from the scope and spirit of the present invention.

I hereby claim the following:

1. A waterfowl motion simulation device which is to be connected to waterfowl decoys to affect the motion of the waterfowl decoys in an aquatic terrain, wherein the waterfowl motion simulation device comprises:

a. a winding unit formed by a motor accommodated inside a winding unit housing and having an output shaft with an end that protrudes from the winding unit housing, a winding implement secured to the end of the output shaft to be rotatable by the motor via the output shaft, and a winding implement cover provided on an exterior surface of the winding unit housing to substantially cover the winding implement;

b. a line assembly having a plurality of decoy attachment appendages to connect to the waterfowl decoys, a main line to which the plurality of decoy attachment appendages is connected that is configured to be wound and unwound with respect to the winding implement in response to the winding implement being rotated bi-directionally, and an anchor appendage configured to connect the main line to an anchor;

c. a control unit having at least one user interface, wherein the control unit is configured to control the motor of the winding unit based on user input received via the at least one user interface to bi-directionally rotate the winding implement;

d. a power supply unit configured to supply a voltage; and

e. a power supply interface that is adapted to removably engage with and support the power supply unit on the exterior surface of the winding unit housing, and through which the control unit is electrically connected to the power supply unit.

2. The waterfowl motion simulation device of claim **1**, wherein the winding unit housing comprises:

a. a container having an opening defined by a rim;

b. a cover configured to be connected to the rim to define an inner cavity in which the motor is accommodated; and

c. a plurality of claw elements rotatably secured on the container externally at points around a periphery of the rim.

3. The waterfowl motion simulation device of claim **1**, wherein the waterfowl motion simulation device further comprises a mounting assembly configured to adjustably support at least in part the power supply unit, the power supply interface, the winding unit, and the control unit above the aquatic terrain.

4. The waterfowl motion simulation device of claim **3**, wherein the mounting assembly further comprises:

a. an adjustment sleeve that defines a passage, and is connected to the exterior surface of the winding unit housing;

b. a main support structure configured to be slidably received within the passage of the adjustment sleeve, wherein the main support structure has an upper end and a lower end opposite the upper end; and

c. a locking mechanism operably associated with the adjustment sleeve to releasably lock the main support structure inside the passage of the adjustment sleeve.

5. The waterfowl motion simulation device of claim **4**, wherein the mounting assembly further comprises a peg element that protrudes from the main support structure in a direction substantially perpendicular to a longitudinal axis of the main support structure, and a plate element connected to the main support structure nearer to the lower end of the main support structure than the peg element.

6. The waterfowl motion simulation device of claim **4**, wherein the waterfowl motion simulation device further comprises an artificial anchor configured to be secured to the line assembly via the anchor appendage and inserted in a ground surface.

7. The waterfowl motion simulation device of claim **4**, wherein the anchor appendage of the line assembly comprises an elastic line, and a plurality of mechanical connectors interconnected by the elastic line, wherein the elastic line in conjunction with the plurality of mechanical connectors is configured to elastically interconnect the main line of the line assembly to the anchor.

8. The waterfowl motion simulation device of claim **4**, wherein the power supply unit comprises at least one battery accommodated inside a power supply housing.

9. The waterfowl motion simulation device of claim **8**, wherein the at least one battery is configured to output a voltage of 20 volts.

10. A method of using the waterfowl motion simulation device of claim **1** to move at least one waterfowl decoy in an aquatic terrain, wherein the method comprises the steps of:

a. positioning the waterfowl motion simulation device above the aquatic terrain at a distance from the anchor;

b. securing the main line of the line assembly to the anchor via the anchor appendage;

c. connecting the at least one waterfowl decoy to the main line of the line assembly via at least one of the plurality of decoy attachment appendages;

d. providing user input indicative of rotational speed and timing of rotational operations of the winding unit to the control unit via the at least one user interface;

e. outputting a motor control signal, based on the user input, from the control unit to the motor of the winding unit;

f. based on the motor control signal, the motor applying torque to the winding implement in a first rotational direction for a first time interval to perform a first rotational operation of rotating the winding implement in the first rotational direction during the first time interval;

g. by rotating the winding implement in the first rotational direction, winding the line assembly with respect to the winding implement to move the at least one waterfowl decoy in the aquatic terrain;

h. at the end of the first time interval, based on the motor control signal, the motor stopping application of torque to the winding implement in the first rotational direction for a second time interval to perform a second rotational operation of rotating the winding implement in a second rotational direction during the second time interval in response to torque applied to the winding implement by the line assembly; and

i. by rotating the winding implement in the second rotational direction, unwinding the line assembly with respect to the winding implement to move the at least one waterfowl decoy in the aquatic terrain.

11. The method of claim **10**, wherein the method further comprises the step of repeating steps (e)-(i) at least one more time.

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