(No Model.) 3 Sheets—Sheet 1.

H. P. GRISWOLD.

ELECTRO MAGNETIC STEERING AND REVERSING MECHANISM FOR TORPEDO BOATS.

No. 333,008. Patented Dec. 22, 1885.

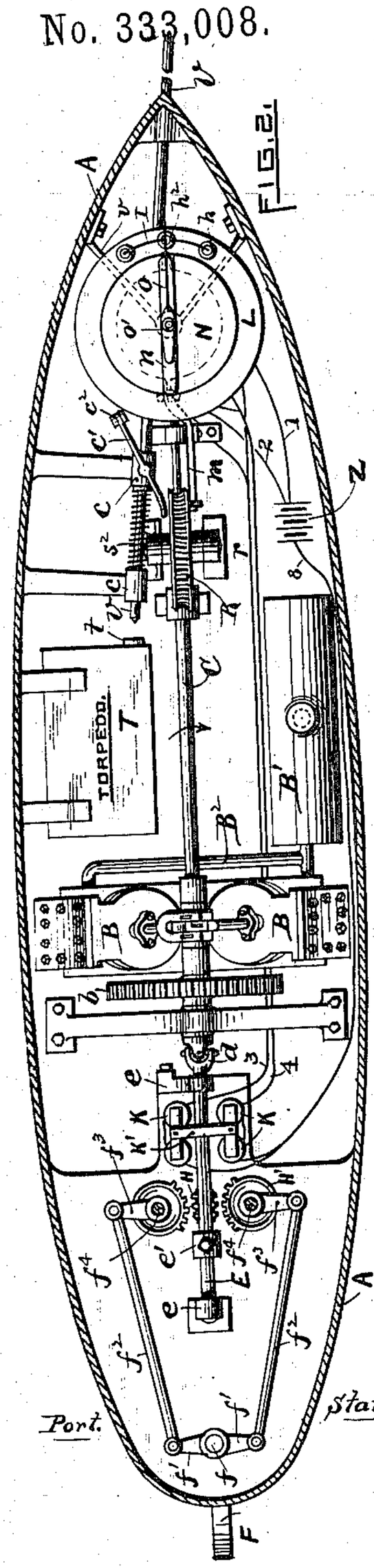

FIG. 2.

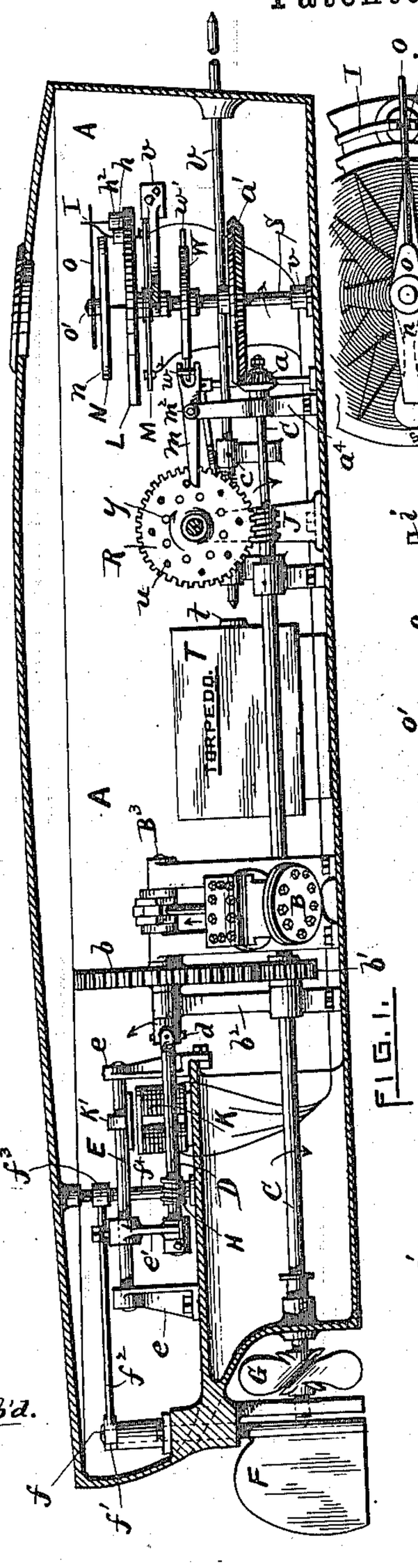

FIG. 1.

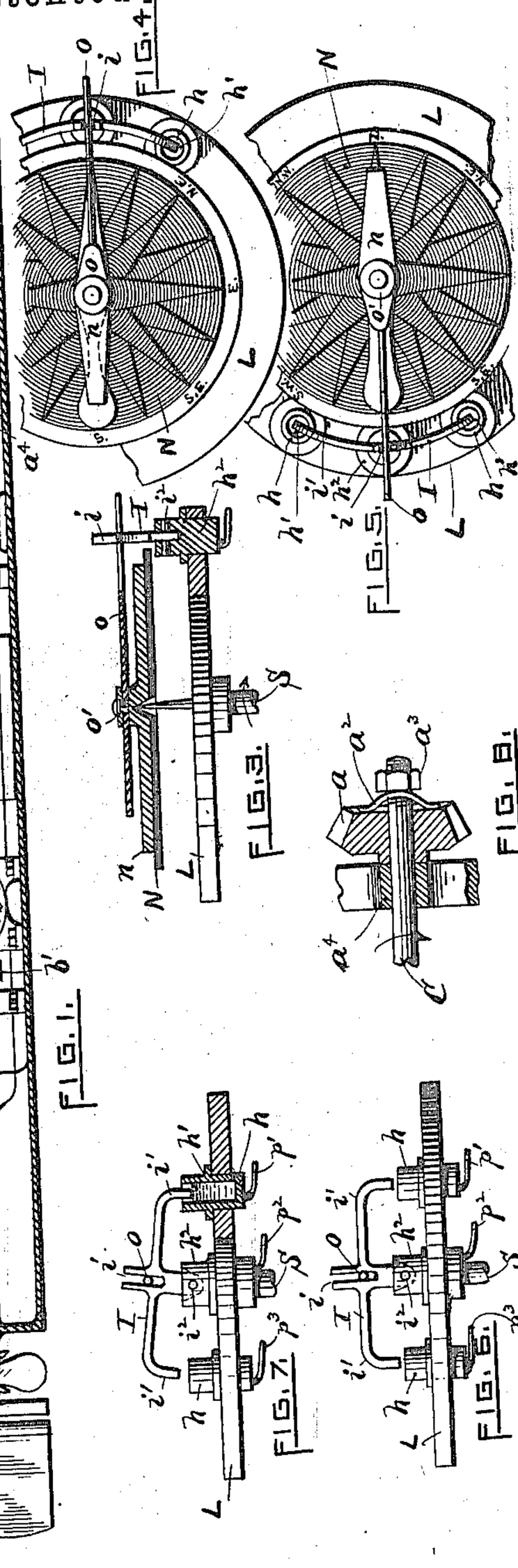

FIG. 4.

FIG. 5.

FIG. 3.

FIG. 8.

FIG. 7.

FIG. 6.

WITNESSES.

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(No Model.) 3 Sheets—Sheet 2.

H. P. GRISWOLD.

ELECTRO MAGNETIC STEERING AND REVERSING MECHANISM FOR TORPEDO BOATS.

No. 333,008. Patented Dec. 22, 1885.

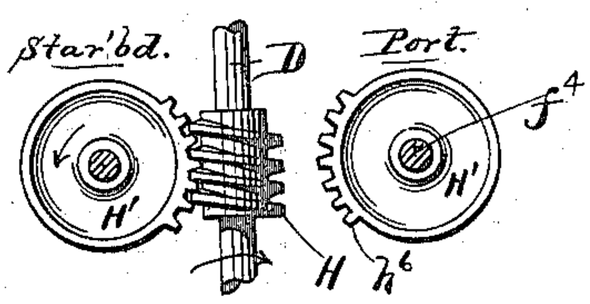

FIG. 10.

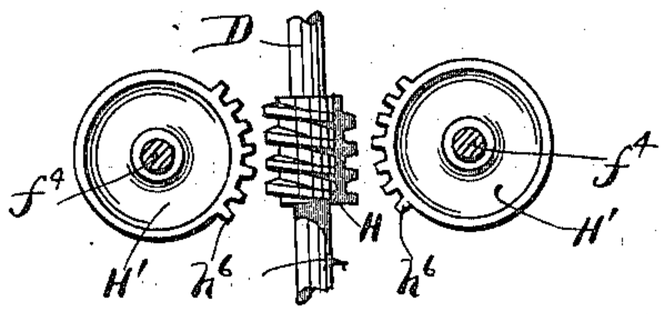

FIG. 12.

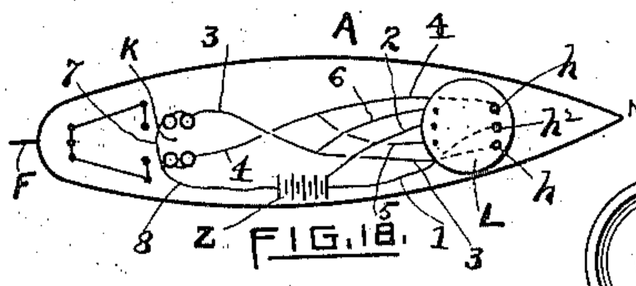

FIG. 18.

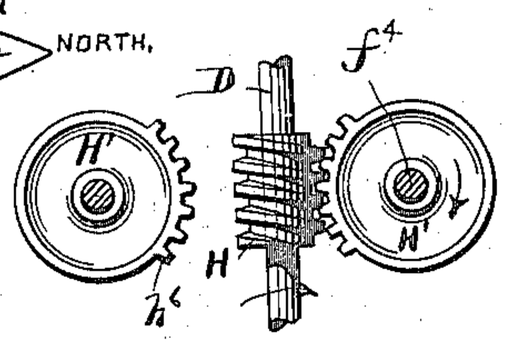

FIG. 11.

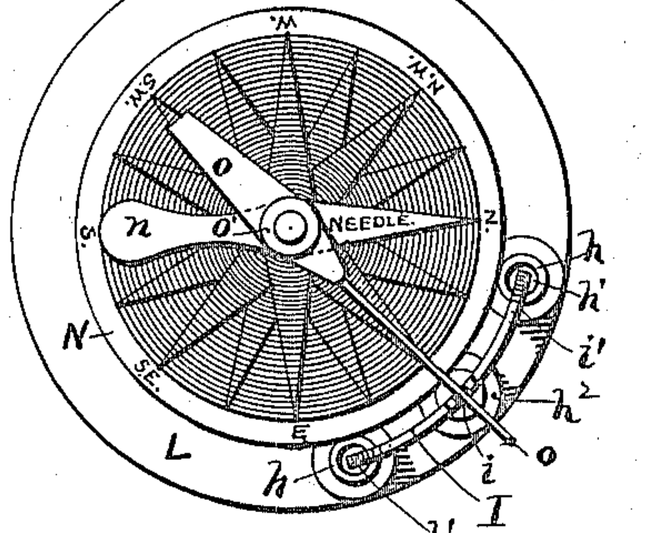

FIG. 9.

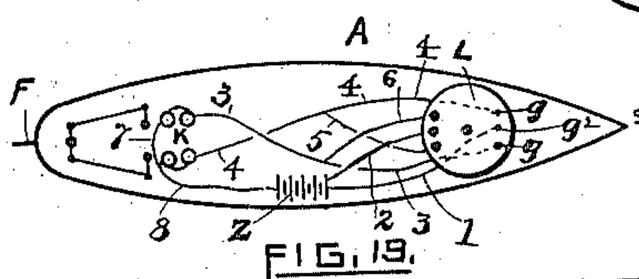

FIG. 19.

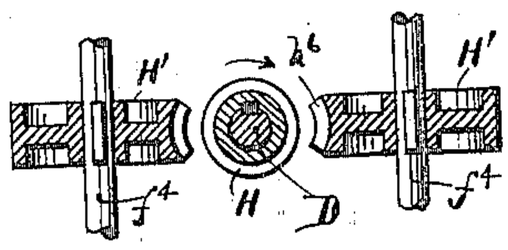

FIG. 13.

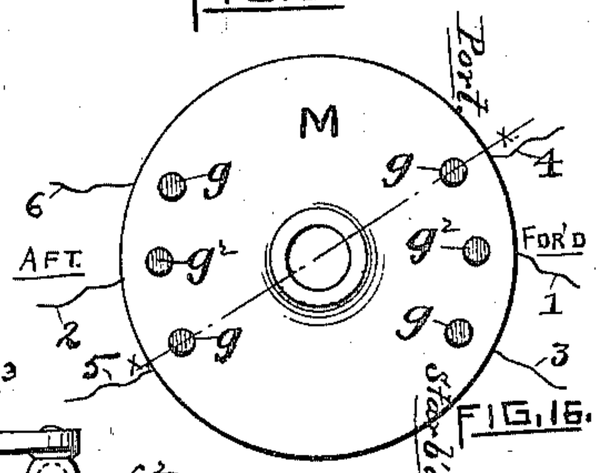

FIG. 16.

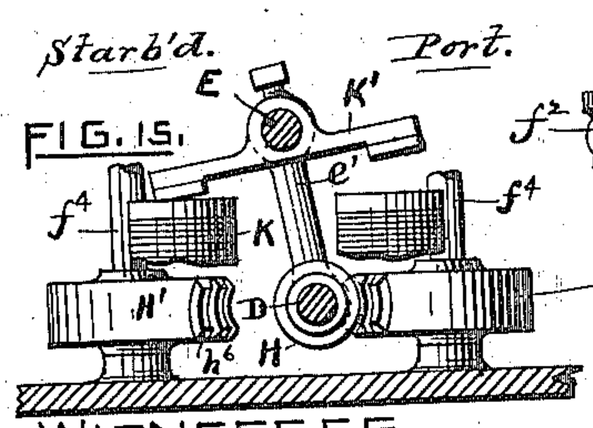

FIG. 15.

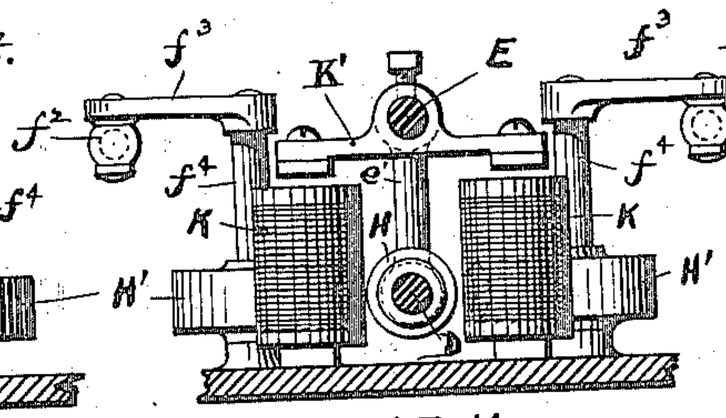

FIG. 14.

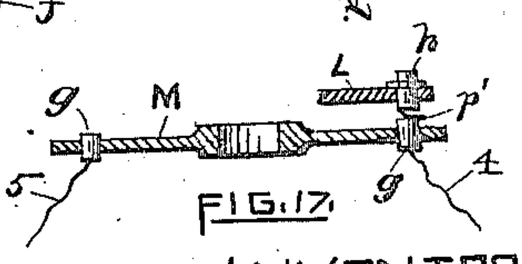

FIG. 17.

WITNESSES.

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(No Model.) 3 Sheets—Sheet 3.

H. P. GRISWOLD.

ELECTRO MAGNETIC STEERING AND REVERSING MECHANISM FOR TORPEDO BOATS.

No. 333,008. Patented Dec. 22, 1885.

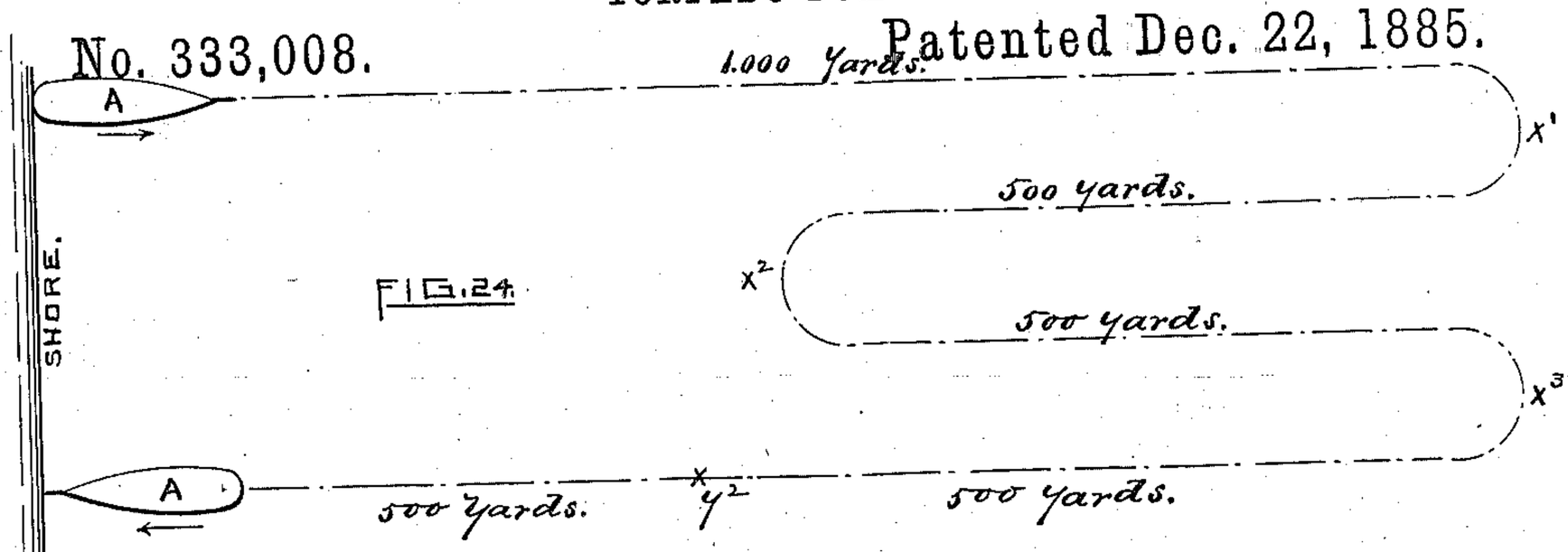


FIG. 24.

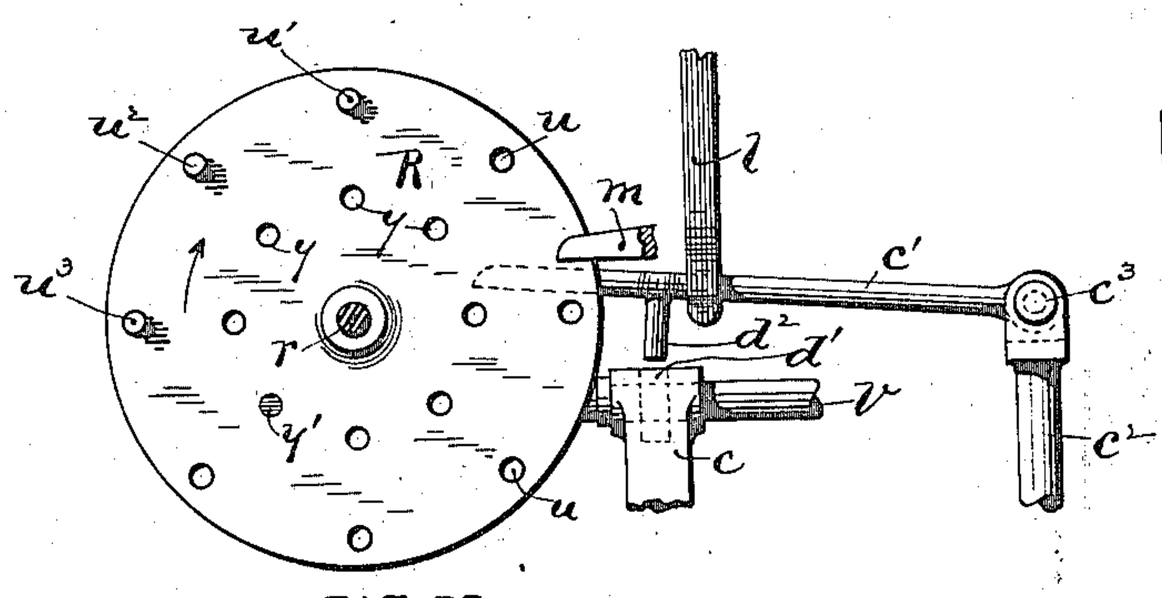
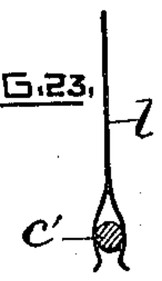


FIG. 20.

FIG. 23.



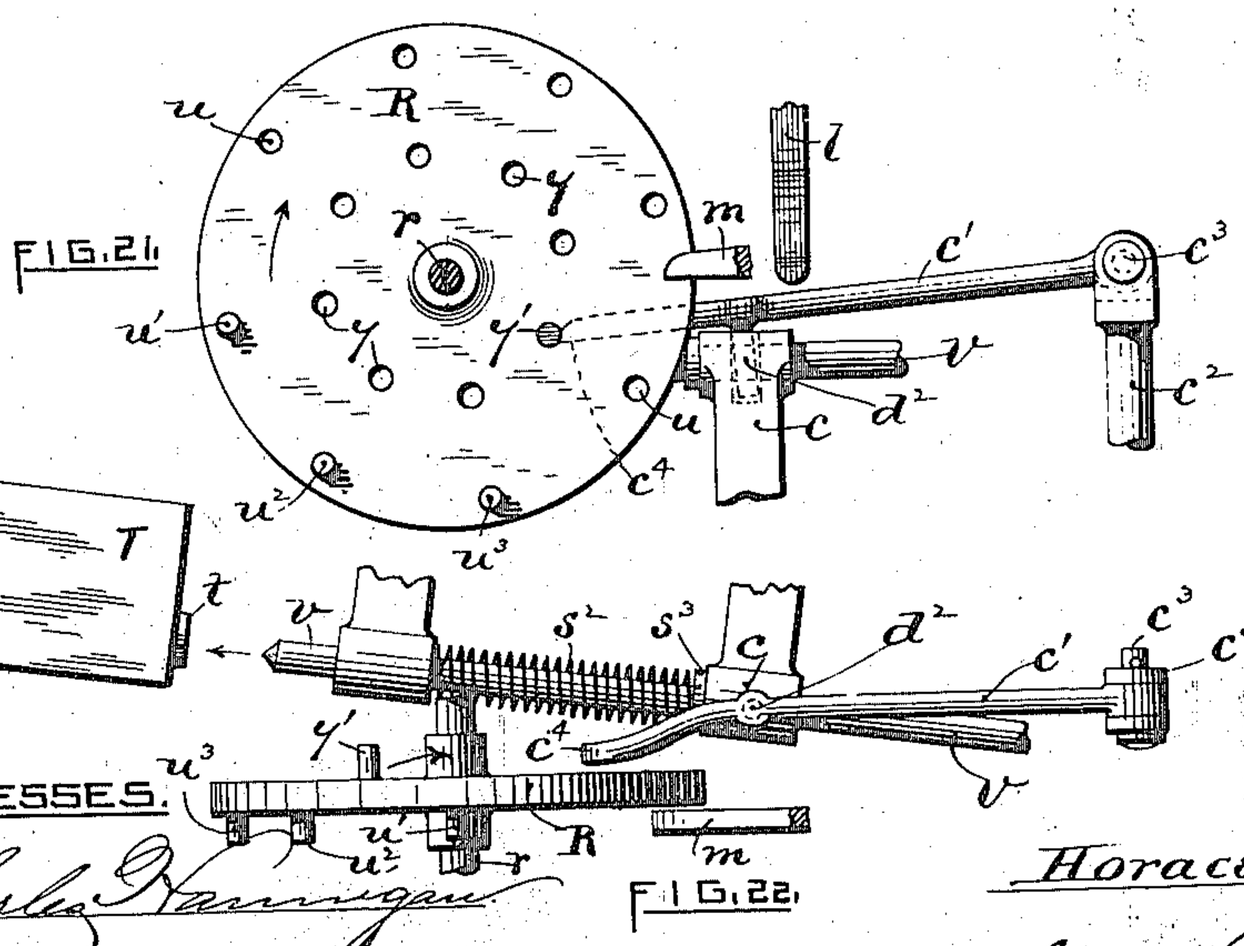


FIG. 21.

FIG. 22.

WITNESSES.

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UNITED STATES PATENT OFFICE.

HORACE P. GRISWOLD, OF PROVIDENCE, RHODE ISLAND.

ELECTRO-MAGNETIC STEERING AND REVERSING MECHANISM FOR TORPEDO-BOATS.

SPECIFICATION forming part of Letters Patent No. 333,008, dated December 22, 1885.

Application filed October 21, 1885. Serial No. 180,477. (No model.)

To all whom it may concern:

Be it known that I, HORACE P. GRISWOLD, a citizen of the United States, residing at Providence, in the county of Providence and State of Rhode Island, have invented certain new and useful Improvements in Electro-Magnetic Steering and Reversing Mechanism for Torpedo-Boats, &c.; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same, reference being had to the accompanying drawings, and to letters or figures of reference marked thereon, which form a part of this specification.

My present invention relates particularly to a device for automatically steering torpedo-boats, rams, &c., in any desired direction by means of electro-magnets, which connect with the steering mechanism, the whole being self-contained within the boat and independent of control from the shore when in use.

My invention consists of a continuously-revolving shaft having a screw-worm secured thereto, one end of which (the shaft) being mounted in an arm or bearing, which is adapted to be vibrated laterally by means of an electric current passing through an electro-magnet, in combination with two toothed wheels or sectors, the angular movement of the latter being transmitted to an arm or tiller secured to the rudder-post, whereby the boat is steered right or left, according as the said worm engages its corresponding toothed wheel, the worm being disengaged from both wheels when the boat is running in its true or "steady" course.

It also consists of a delicate arm or finger adjustably secured to the compass needle and card, in combination with an insulated disk carrying two mercury-cups and a pivot, upon which a forked two-arm lever is adapted to vibrate, a battery or other generator of electricity, which connects said mercury-cups, pivot, and electro-magnets, before referred to, whereby any variation of the boat from its course causes the said finger to tip or deflect the forked lever so that the latter is made to engage its corresponding mercury-cup, thus making an electric connection with the electro-magnets, and causing the worm to swing into contact with one of the toothed wheels for the purpose of operating the rudder, the boat thereupon immediately answering the helm and resuming its course, the magnetic needle at the same time returning to its true or normal position, by means of which the finger is withdrawn from the mercury-cup and breaks the electric circuit.

The invention further consists of an insulated disk secured to a vertically-supported spindle, which is adapted to be revolved by means of frictional gearing, a revolving dial provided with one or more removable pins, which engage an escapement-lever, the latter in turn adapted to engage an escapement-wheel secured to said spindle, the dial being connected with the slow-moving gears of a clock-train or to a shaft driven by the propelling-motor. By means of this latter combination the boat is enabled to be reversed in its course without reversing the engines—that is to say, the boat can run ahead in its course any predetermined distance, say, five hundred yards, when, by means of the action of the escapement and its mechanism, the compass-card, &c., is revolved one hundred and eighty degrees, thus bringing the mercury-cups aft of the spindle. The boat then turns one hundred and eighty degrees and runs in the opposite course, say, one hundred yards. The moving parts are again reversed, which brings the mercury-cups, &c., forward of the spindle to their normal position. The boat, now responding to the helm, again turns one hundred and eighty degrees and runs one hundred yards, more or less, in its original course, as predetermined by the relative arrangement of the pins in the revolving dial, after which another half-revolution of the spindle, as before described, causes the boat to finally turn and run in the opposite course again until the shore is reached, unless it meets with an obstruction.

The invention finally consists in combining with the above-mentioned dial carrying pins adapted to engage an escapement-lever, &c., another removable pin mounted in said dial, which engages with certain locking mechanism at a predetermined point in the boat's course, whereby a pin or key is automatically inserted into the firing pin or arm, which explodes the torpedo carried within the vessel.

By means of this latter device a person may handle the boat upon its arrival inshore with comparative immunity from danger, all as will be more fully hereinafter described and claimed.

In the accompanying three sheets of drawings, which I have prepared to illustrate my improvements, Figure 1, Sheet 1, represents a longitudinal central sectional view of a submarine torpedo boat, showing the relative arrangement of the several parts comprising the invention. Fig. 2 is a horizontal sectional plan view of the same. Fig. 3 is an enlarged vertical sectional view of the compass card, needle, &c. Fig. 4 is a plan view of the same, the boat's course being due north and "steady." Fig. 5 is a similar plan view showing the position of the needle, &c., reversed, the same corresponding to a south course. Fig. 6 is a front view in elevation of the insulated disk having mercury-cups therein, and also the forked lever, the arms of which are in the normal or non-contact position. Fig. 7 is a similar view showing a portion of the disk and one of its cups in central section, the forked lever being tipped laterally by means of the compass-needle, thereby causing one arm of the lever to engage an open mercury-cup and closing the electric circuit. Fig. 8 is a detached sectional view showing a toothed wheel frictionally mounted on its driving-shaft. Fig. 9, Sheet 2, is a plan view of the compass-card, &c., showing the parts adjusted to run the boat in a northeast course. Fig. 10 is a detached view, enlarged, showing the screw-worm in contact with the starboard toothed wheel, by means of which the rudder is carried to starboard, thus causing the boat's head to diverge from its course toward the right. Fig. 11 is a similar view, the worm, however, being in contact with the port wheel, corresponding to a port course. Fig. 12 represents the screw-worm in its normal position, disengaged from both wheels, the rudder then standing "fore-and-aft" or steady. Fig. 13 is a vertical central sectional view corresponding to the preceding figure. Fig. 14 is a detached view, enlarged, showing the electro-magnets and the armature therefor, having the revolving worm-shaft mounted in an arm depending therefrom, said worm, &c., being in the normal position indicated by the two preceding figures. Figure 15 is a similar view showing the worm swung into engagement with the port wheel by means of the electric current passing through the magnets. Fig. 16 is a plan view (reduced) of a stationary disk or plate, the same being insulated, and provided with electrically-connected plugs so arranged that the mercury-cups and pivot of the movable insulated disk coincide and connect therewith in either position, whether the cups stand forward or aft of the spindle. Fig. 17 is a central sectional view of the same, showing a portion of the movable disk, one of the mercury-cups thereof being in contact with one of the said electrically-connected plugs. Fig. 18 is a reduced plan view of the boat, showing the arrangement of the conducting-wires which form the electric circuit, the mercury-cups being forward of the spindle, and the boat sailing in (say) a north course. Fig. 19 is a similar view, the movable disk, however, having been revolved one hundred and eighty degrees on its axis, thereby bringing the mercury-cups aft of the spindle, and causing the boat to turn and run in an opposite or south course. Fig. 20, Sheet 3, is an enlarged view showing the revolving dial provided with pins adapted to engage a lever (shown broken) by means of which the course of the boat is reversed, said view also showing the safety or locking device, the lever therefor being retained in its normal position by a spring-catch. While in this position the torpedo is adapted to be exploded. Fig. 21 is a similar view, except that the dial has been turned on its axis about three-fourths of a revolution, which movement reversed the course of the boat three times, and finally withdrew the safety-lever from its spring-catch, thereby forcing the pin down into the opening formed in the exploding-rod and locking it (the rod) in the safety position. Fig. 22 is a plan view of the parts represented in Fig. 20. Fig. 23 is a detached view of the spring-catch with the lever retained therein; and Fig. 24 represents, approximately, the course of the boat after leaving the shore until its return thereto, and corresponding to the relative arrangement of the pins, &c. (Shown in Figs. 20, 21, and 22.)

The following is a more detailed description of the improvements hereinafter claimed. I would state, however, in passing, that heretofore, so far as I am aware, the movements of this class of torpedo-boats, rams, &c., have been controlled through the agency of electricity by the manipulations of an operator stationed on shore, the electric current passing through one or more cables, which connect the boat with the battery, &c., on shore, such control, even at the best, being unsatisfactory.

By means of the present improvements I design to practically overcome most of the objections urged against the former systems. To this end A, again referring to the drawings, designates the boat as a whole, the form and construction of its hull, as well as of the materials composing it, being as common to boats of this type wherein the torpedo or other explosive is carried within the boat, such boats in service being wholly or partially submerged, as may be desired, the object being, mainly, of course, to destroy an enemy's vessel by contact therewith, thus causing the explosion of the torpedo and consequent loss of said vessel, although practically demolishing the torpedo-boat itself.

As before stated, A indicates the boat, provided with a rudder, F, and propeller G, the latter being secured to a shaft, C, which is driven by means of the motor or engine B, acting through the gears *b b'*, steam, compressed air, or other suitable gas or vapor

being supplied to said engine under pressure from the charged tank or reservoir B′, as common, and to which I make no claim. Electricity also may be successfully employed to propel the boat through the water.

D indicates a continuously-revolving shaft connected by a universal joint, *d*, to the engine-shaft, as drawn, although any other suitably driven and mounted shaft may be used. Secured to the rear or after portion of the shaft is a screw-worm, H, said shaft being journaled in an arm, *e′*, depending from a rod, E, mounted in bearings *e e*, Figs. 1, 2.

K K designate a pair of electro-magnets, having the shaft D passing freely between them, the armature K′ of the magnets being also secured to the rod E, before described.

f^4 f^4 are suitably-mounted vertical shafts, between which the shaft D also passes. To the lower end of each shaft f^4 is secured a wheel, H′, having teeth h^6 extending about ninety degrees around its peripery, said wheels being so placed that the worm H will not intergear with either in its normal position. To the upper end of each shaft f^4 is secured an arm, f^3, which in turn connects with the lever or tiller *f′* by means of a link, f^2, all as fully shown. It is obvious that as the armature K′ is vibrated or deflected by means of the electric current toward port or starboard, so also will the end of the shaft D be moved laterally, and the worm H be made to engage its corresponding wheel, H′, thereby causing the rudder to move and change the direction of the boat in its course. The shaft C, as drawn, extends forward, and has a small bevel-toothed wheel, *a*, loosely mounted thereon, a spring, a^2, and adjusting means a^3 also being connected therewith.

S indicates a vertical spindle mounted in suitable bearings, *v*, at the forward end of the boat. Said spindle has a bevel-gear, *a′*, secured thereto adapted to intergear with the wheel *a*. A "two-pin" escapement-wheel, W, is also secured to the spindle S, the latter wheel engaging the escapement-lever *m*, pivoted at m^2 to the standard a^4, the construction and operation of this escapement being as common, and to which I make no specific claim.

Upon the shaft C, aft of the gear *a*, is secured a worm, J, which engages or operates a dial, R, secured to the axle *r*, the latter being suitably mounted. Near the outer edge of said dial is drilled a circularly-arranged series of holes, *u*, adapted to receive pins *u′*, &c., Sheet 3, by means of which the latter engage the rear end of the escapement-lever to release the wheel W, and permitting the spindle to revolve one hundred and eighty degrees on its axis.

I do not restrict myself to the use of the dial and worm as shown, as the escapement may be effected by the employment of a slow-moving clock-train having a perforated dial adapted to carry said pins *u′*, &c., and operate the lever *m*, the pressure or tension of the spring a^2 against the wheel *a* being such that as long as a pin, *w′*, of the wheel W bears against a pin, w^2, of the lever, the spindle is prevented from turning on its axis, the shaft *c* then freely revolving in the wheel *a;* but as soon as the pin *w′* is released by the movement of the lever *m*, then said spring overbalances the friction of the spindle and its connections, and causes the wheel *a* to drive the spindle around one hundred and eighty degrees, after which it (the spindle) remains stationary until again released, as before.

An important improvement intimately connected with this mechanism consists in drilling another series of circularly-arranged holes, *y*, in the dial R, said holes, however, being located nearer the hub, and adapted to receive a pin, *y′*, the latter in turn engaging the free end c^4 of a pivoted lever, *c′*, supported by a spring clip or holder, *l*, by means of which the lever is adapted to be automatically withdrawn from said holder for purposes about to be described.

V indicates a rod suitably mounted in the boat and projecting through the hull in front, the rear portion of the rod passing through supports *c*, and having its end adapted to explode the cap *t* of a torpedo, T, a spring, s^2, bearing against a collar, s^3, of said rod serving to force the latter forward against the bearing *c*. A hole, *d′*, is now drilled down into the bearing and through the rod. A pin, d^2, is secured to and extends downwardly from the lever *c′*, before described, for the purpose of passing into said hole *d′* and thus lock all the parts together, thereby preventing the rod V from moving rearwardly to explode the torpedo, all as fully shown in Sheet 3. To the top of the spindle S is pivoted the magnetic compass-needle *n*, which is secured to a compass-card, N, as usual. A delicate finger, *o*, is adjustably secured to and projecting beyond the needle *n*, as shown in Fig. 3, &c.

L indicates a disk made of suitable insulating material, the same being secured to the spindle S, and provided near its edge with the metallic cup or plug h^2, the latter having the small slotted two-arm lever I pivoted thereto at i^2, the slot *i* being adapted to receive the outer or free end of the finger *o*, before described. Extending from and at right angles to the slotted portion of the lever I are the oppositely-formed arms *i′*, the outer ends thereof being bent downwardly to enter the open end of the metallic cups *h h*, which are secured one on each side of the center cup, h^2, to said disk L, as fully shown in Sheet 1.

M designates an insulated disk, the latter, however, being stationary and secured to the upper bearing, *v*. Said disk is provided with two metallic plugs, g^2, which are arranged in line fore-and-aft. Arranged on either side of these plugs are secured to the disk four additional plugs, *g*, as fully shown in Fig. 16, both sets of plugs being so placed and secured to the disk that the cups h^2 *h* of the disk L, before described, stand directly over the for-

ward set of plugs, g^2 g, if the boat be running in its forward course, or over the opposite or after set of plugs when the disk L is reversed in position for the purpose of reversing the boat's direction.

The electric connections are as follows: Z designates a battery or other generator of electricity, secured on board the boat, from which extend wires, Fig. 18, connecting said plugs g^2 g and electro-magnets K, the wires being numbered as indicated therein. 1 is the wire which connects the battery and the forward plug g^2 together. 2 is the wire connecting the battery and the after plug g^2. 3 is a wire which connects the forward starboard plug g and the port electro-magnet, 4 being a wire connecting the forward port plug g and the starboard electro-magnet. 5 is a wire adapted to connect the after starboard plug g with the wire 4 leading to the starboard electro-magnet. 6 is a similar wire connecting the after port plug with the wire 3, leading to the port electro-magnet. 7 is a short wire connecting both the port and starboard electro-magnets K K, and 8 is a return-wire connecting said magnets and battery Z to complete the electric circuit.

The manner of adjusting and setting the several parts hereinbefore described, for the purpose of running the torpedo-boat may be stated substantially as follows: The course of the boat is first decided upon, which, say, will be to run it one thousand yards north, then reverse and run south five hundred yards, again reverse and run five hundred yards north, and finally, reverse and run south five hundred yards, when, if no obstruction is presented to the projecting rod V, the safety-catch d^2 will then be forced down to lock the rod in position, the boat meanwhile continuing in its southern course about five hundred yards more until the shore is again reached, substantially as indicated in the diagram shown in Fig. 24. The pins u' u^2 u^3 are now inserted in holes u of the dial R, Fig. 20, the distance between the centers of said holes corresponding, say, to a run of five hundred yards at a certain speed of the propeller. The pin y' is then inserted in an opening, y, for the purpose of locking the torpedo-rod at the proper time. (See also Fig. 20.) The finger o is then secured in place directly over and in line with the needle n, (for a north course,) substantially as shown in Figs. 1 and 2, the mercury-cups and pivot of the disk L being forward of the spindle. The tank or reservoir B′ is now charged with steam, compressed air, gas, or other suitable vapors under high pressure. The safety or locking lever c' is swung up into engagement with the spring-holder l, thereby permitting the torpedo to be exploded by means of the rod V whenever the latter comes in contact with an obstruction sufficient to overcome the resistance of the spring s^2. The steam is now admitted into the cylinders B, and the boat started on its northern course, the shafts revolving in the arrow-direction shown in Fig. 1. Now, in case the boat varies a little from its course, say, toward the east, the magnetic needle n will of course seek to point due north, and, consequently, move toward the left or port, which movement, by means of the finger o secured thereto, deflects the pivoted forked lever I and causes the lower end of its left arm, i', to come in contact with the mercury h', contained in the corresponding cup, h, Fig. 7, thereby forming an electric circuit which includes the electro-magnets K K. The electric current now passes along the wire 4 (through the medium of the cup h, its spring connection p', and the corresponding plug g, Figs. 16 and 17) to the starboard electro-magnet K, thereby charging the latter, and causing the armature K′ to vibrate and engage therewith, which movement at the same time carries the revolving worm H into gear with the port-wheel H′, Figs. 11 and 15, thereby driving the latter in the arrow-direction and swinging the rudder F to port. The boat, answering the helm, soon resumes its normal or steady course. This latter movement of the boat causes the arm i' to leave the mercury, Fig. 6, thus breaking the electric circuit, the armature, &c., then being in the position shown in Figs. 12, 13, and 14, the same corresponding to the steady course.

Any deflection of the boat to the west or port will result in connecting the arm i' with the wire 3, leading from the starboard plug g to the port electro-magnet, thus making the circuit and causing the armature to vibrate to the port side and swing the worm H into gear with the starboard wheel, H′, and the consequent movement of the rudder to starboard, all as before stated, except that the operation is reversed. Now, as the boat reaches the end of its first or one thousand yards course the pin u' engages the escapement-lever m, thereby releasing the pin w^2 and permitting the spindle S to be turned one-half of a revolution, the lever with its pin w^2 meantime returning to prevent the wheel W from further axial movement, the disk L, &c., then being in the position represented in Fig. 5, wherein the cups h h^2 and needles n o are aft of the spindle and pointing south. By means of this reversal of position (see, also, Fig. 19) and the persistent tendency of the magnetic needle n to point toward the north, the electric circuit is again formed and the armature electrically connected with one of the electro-magnets K, thus bringing the worm into gear and causing the rudder to move to its extreme port or starboard position, the same being about forty-five degrees from the steady line. The teeth h^6 of the wheels H′ extend about ninety degrees around its circumference, as shown. It is obvious that as the rudder reaches its extreme position, so, also, at the same time will the wheel be revolved to its extreme limit, the worm then bearing against the smooth portion of the rim and preventing further movement thereof. As the boat turns at x' in its course and gradually assumes a straight southern course, the needle n then is pointing due north

or astern. Any variation of the boat will now cause the arms i' to deflect right or left into the mercury-cups, thereby again turning the rudder in the proper direction by means of the electric circuit, to head the boat in its true course, as before described. After running south five hundred yards the pin w^2 releases the escapement mechanism, thereby turning the spindle another half-revolution, which movement places the cups and needles forward of the spindle, the boat gradually turning in its course at x^2, as just described, and again runs north, when, after sailing five hundred yards in this direction the continuously-revolving dial R causes the pin w^3 to release the escapement mechanism and again revolve the spindle and its attachments one-half turn, the needle, &c., then pointing astern or south. As before stated, the magnetic needle n bears toward the north, thereby keeping the electric circuit closed until the boat passes the center x^3 and heads due south, at which time the needle will point due north or astern. The boat now continues in its south course about five hundred yards, when the pin y', mounted at the back of the dial R, engages the free end c^4 of the suspended lever c' and forces it from the spring-holder l, thereby inserting the pin d^2 of the lever down into the opening d' of the torpedo-rod V and its bearing c, (see Fig. 21,) and preventing endwise movement of said rod to explode the torpedo. This latter operation occurs at the point y^2 in the diagram. The boat still continues on its course about five hundred yards until the shore is again reached, as fully shown.

It is obvious that the mechanism may be readily set and adjusted to run the boat in other directions and for longer or shorter courses, as desired.

It is evident that by means of this invention the engines or other propelling motor always runs in the same direction, and is not reversed, an opposite or different course for the boat being effected by means of the reversal of the needles, &c., which results in the consequent turning of the boat, all as before described.

I am aware that patents have been issued to Ballard, Lay, and Washburn, the same being numbered and bearing date, respectively, as follows: No. 107,326, of September 13, 1870, No. 198,126, of December 11, 1877, and No. 313,901, of March 17, 1885. Therefore I do not claim, broadly, a boat-steering device controlled by means of an electric current; but the steering mechanism herein described, together with the magnetic needle having a finger adjustably secured thereto engaging a lever adapted to electrically connect metallic cups or plugs secured to an insulated disk rigidly mounted on a spindle adapted to be intermittently revolved, and the automatically-operated safety or locking device for the torpedo, are both new and useful.

What I do claim and desire to secure by United States Letters Patent, is—

1. In a boat of the character hereinbefore described, the combination, with the rudder, of a shaft having a screw-worm secured thereto, mechanism for revolving the same, a journaled rod having an arm adapted to support the free end of said shaft, two worm-wheels suitably mounted, having the worm arranged to freely revolve between and independently of said wheels, and levers or other substantially equivalent means which connect each wheel with the rudder, the whole arranged whereby the journaled rod is adapted to vibrate and cause the revolving worm to engage either wheel, the angular movement of the latter being transmitted to the rudder, substantially as shown, and for the purpose set forth.

2. The combination, with a rudder connected with a worm-wheel mounted on each side of the center of the vessel, a worm secured to a jointed shaft intermediate of said wheels, and mechanism for revolving the shaft, of a loosely-mounted rod provided with an arm having the free end of the worm-shaft journaled therein and a pair of electro-magnets having the armature thereof secured to said rod, the whole combined and arranged whereby the worm is disengaged from both wheels when the magnets are demagnetized, and engaging either wheel, according as the armature is attracted and vibrated toward either magnet by means of an electric current passing through it, substantially as shown and hereinbefore set forth.

3. In a boat of the class described, the combination, with the rudder, connections, worm-wheels, and electro-magnets having the armature thereof secured to a rod which carries the revolving shaft and worm, substantially as shown, of a compass needle and card, mounted as usual, a finger adjustably secured to the needle, a pivoted two-arm lever adapted to receive the free end of said finger, two mercury or contact cups secured below the lever, adapted to each to receive an arm thereof, and suitable conducting-wires connecting said cups, lever, and electro-magnets with a battery or other suitable source of electricity to produce a circuit, the whole arranged on board the vessel, whereby any material variation of the boat from a straight course is immediately counteracted by the magnetic needle, which latter causes the corresponding arm of the pivoted lever to engage its corresponding mercury-cup, thereby closing the electric circuit and instantly deflecting said armature, thus swinging the worm into gear with one of the wheels and moving the rudder, substantially as shown and set forth.

4. In a boat of the class herein described, having a suitable electric battery and propelling mechanism, the combination, with the electrically-connected steering device, compass needle, card, and adjustably-secured finger, of a suitably-mounted spindle adapted to be intermittently revolved one hundred and eighty degrees, mechanism, substantially as shown and described, for effecting the same, a

set of three electrically-connected stationary metallic plugs secured forward of the spindle, and a similar set of plugs secured aft of the spindle, an insulated disk secured to and revolving with said spindle, the disk having a forked two-arm lever pivoted thereto, and the two mercury-cups, said lever and cups being electrically connected with either set of stationary plugs, the whole combined and arranged, whereby the boat is automatically reversed in its course, said device being self-contained and independent of control from the shore.

5. The combination, with the suitably-mounted firing-pin or torpedo-exploding rod having an opening formed therein, of the pivoted suspended lever having a pin secured thereto and a revolving dial provided with a pin adapted to engage said lever, whereby the latter is released and its pin made to enter the said opening, thus locking the rod in position and preventing it from exploding the torpedo, substantially as shown and set forth.

6. In a compass, the combination, with the insulated disk secured to a spindle adapted to be automatically revolved, provided with two electrically-connected mercury-cups and an electrically-connected pivot, on which a forked two-arm lever is adapted to vibrate, of a magnetic needle and its compass-card, mounted as common, having a delicate finger adjustably secured to the top of the needle, the free end of the finger extending beyond the needle and engaging the forked or slotted portion of the two-arm lever pivoted to said insulated disk, substantially as shown, and for the purpose set forth.

7. The improved automatic electro-magnetic steering and reversing apparatus hereinbefore described, the same consisting of the electro-magnets K K, having the armature K′ thereof secured to a freely-mounted rod, from which depends an arm, e', in which a revolving jointed shaft, D, carrying the worm H, is journaled, toothed wheels H′, mounted each on a shaft, f^4, from which extends an arm, f^3, that connects with the tiller f' of the rudder, a suitably-mounted spindle, S, adapted to be revolved by means of the gear a, frictionally mounted on a revolving shaft, c, and a gear, a', secured to said spindle, an escapement-lever, m, operated by means of one or more pins, u' u^2 u^3, carried by a revolving dial, which releases the wheel W, secured to the spindle S, an insulated stationary disk, M, having the two sets of electrically-connected plugs g g^2 secured thereto, the insulated disk L, provided with the two mercury-cups h, and pivot h^2, secured to said spindle, a slotted two-arm lever, I, mounted in the pivot h^2, a compass-card, N, magnetic needle n, and finger o, adjustably secured to the needle and surmounting the spindle, a battery, Z, or other generator of electricity, and the electric conducting-wires connecting the several plugs g g^2, cups h h, pivot h^2, electro-magnets K K, and battery Z, to form the circuit, the whole combined, arranged, and adapted for use substantially as shown and set forth.

In testimony whereof I have affixed my signature in presence of two witnesses.

HORACE P. GRISWOLD.

Witnesses:
CHARLES HANNIGAN,
GEO. H. REMINGTON.