A. T. NELSON.

AUTOMATIC STEERING DEVICE.

APPLICATION FILED FEB. 12, 1906. RENEWED JUNE 15, 1908.

1,015,061. Patented Jan. 16, 1912.

3 SHEETS—SHEET 1.

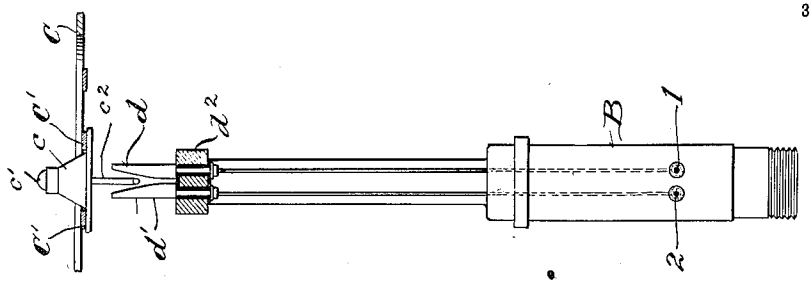

Fig. 2.

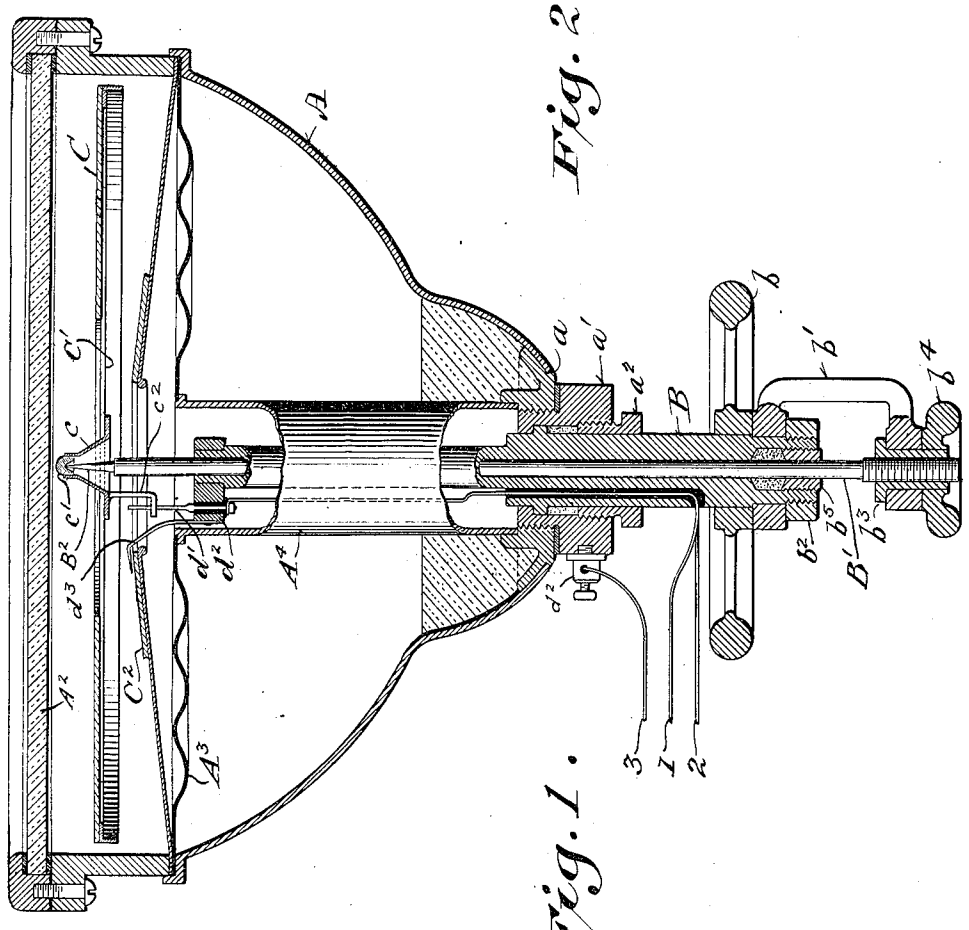

Fig. 1.

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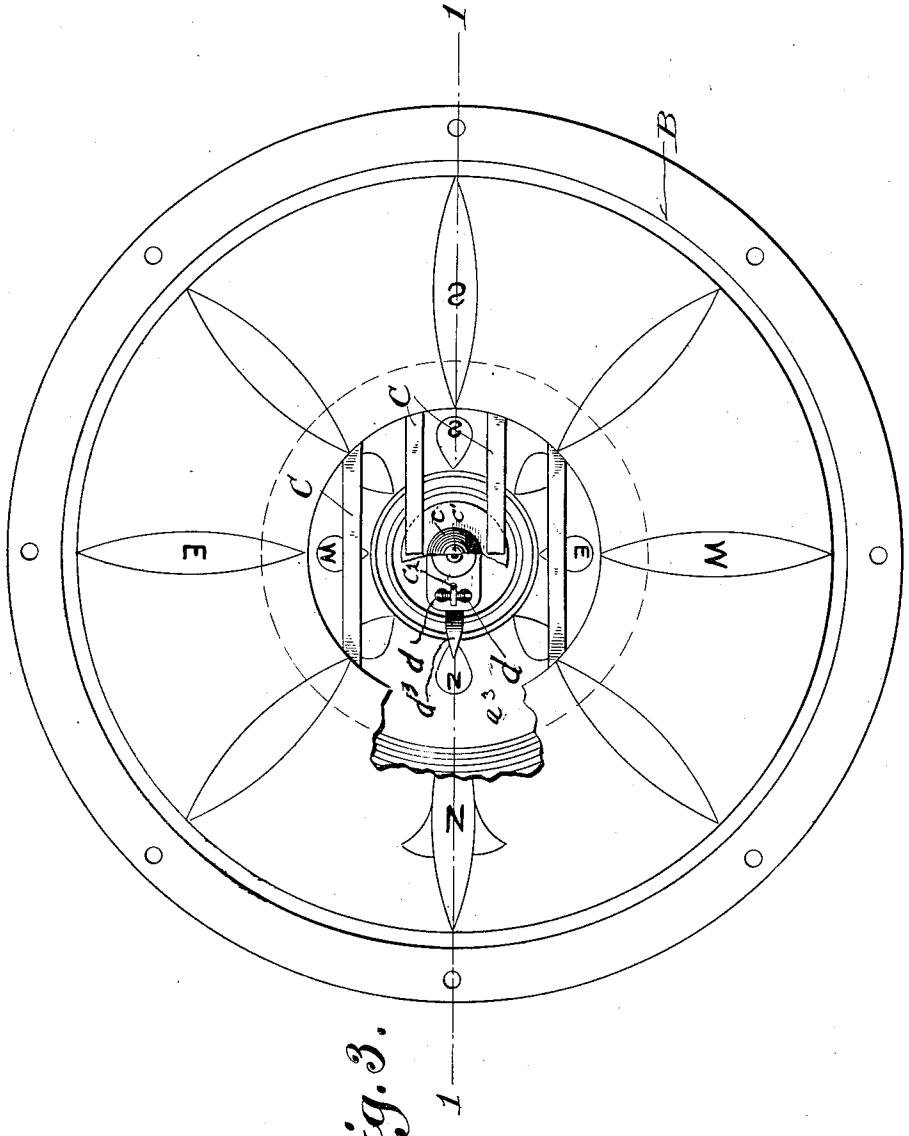

Fig. 3.

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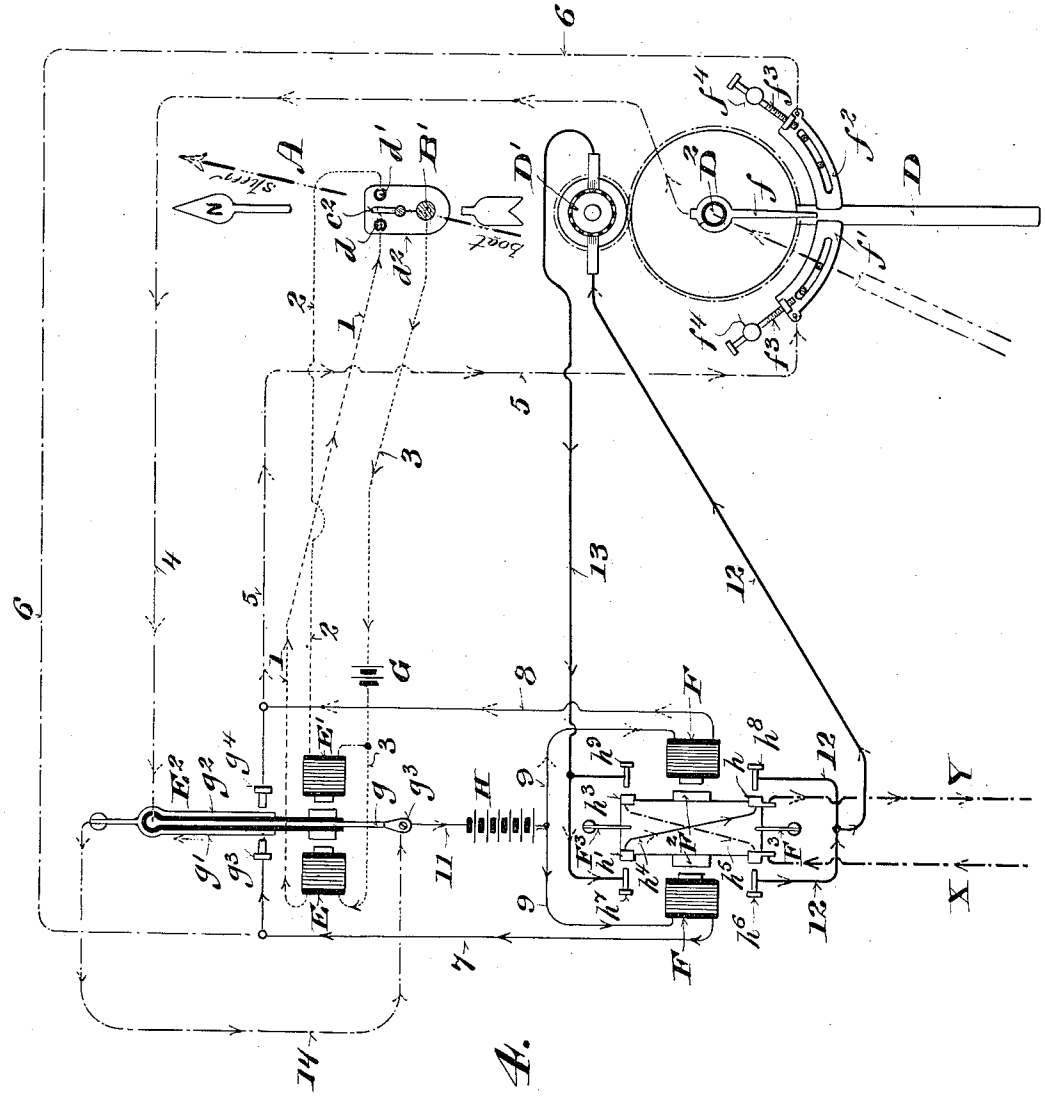

Fig. 4.

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UNITED STATES PATENT OFFICE.

AUGUST T. NELSON, OF MILWAUKEE, WISCONSIN, ASSIGNOR TO AUTOMATIC STEERING COMPANY, OF MILWAUKEE, WISCONSIN, A CORPORATION OF WISCONSIN.

AUTOMATIC STEERING DEVICE.

1,015,061. Specification of Letters Patent. Patented Jan. 16, 1912.

Application filed February 12, 1906, Serial No. 300,685. Renewed June 15, 1908. Serial No. 438,591.

To all whom it may concern:

Be it known that I, AUGUST T. NELSON, a citizen of the United States, residing at Milwaukee, in the county of Milwaukee, State of Wisconsin, have invented a new and useful Improvement in Automatic Steering Devices, of which the following is a specification.

The object of my invention is to provide simple, economical and accurate means whereby marine crafts may be automatically steered upon a predetermined course, the construction and arrangement being such that the permanent magnet of a mariner's compass primarily controls the opening or closing of electric circuits, by means of which circuits a motor in gear-connection with a craft's rudder is actuated. To change the position of the rudder, should said craft deviate from her course, the motor being thereafter reversed to return the rudder to its normal or fore-and-aft position.

The invention therefore consists in various electrical appliances and combinations of mechanical parts as hereinafter clearly set forth with reference to the accompanying drawings and subsequently claimed.

In the drawings: Figure 1 represents a vertical sectional view of a compass embodying certain novel features of my invention, the section being indicated by line 1—1 of Fig. 3; Fig. 2, a detailed elevation of the arbor illustrating the contact points and guide sleeve and the method of making and breaking the electric circuit through movement of the compass magnets; Fig. 3, a plan view of the compass with parts broken away to better illustrate the novel mechanical details, and Fig. 4, a diagram view of the entire apparatus embodying the features of my invention in connection with the various electrical circuits whereby the apparatus is controlled.

Referring by characters to the drawings, A indicates a compass-bowl provided with a liquid-compartment, which is located between a glass face-plate A^2 and a fluted diaphragm A^3, the diaphragm being connected to and communicating with a central well formed by a cylindrical jacket A^4, as shown in Fig. 1. The bowl and its connected parts form a compass-casing, which casing is suitably suspended in a frame that forms no part of my invention and is consequently not shown. To the lower part of the bowl is secured a head a, which head is in screw-threaded connection with the jacket A^4, there being a slightly reduced central threaded aperture in said head for the reception of a cap a^1. This cap serves as a support for an arbor B that is revolubly mounted therein, a water-tight joint being maintained between the arbor and cap by a gland a^2 that is in screw-thread connection with said cap, which cap, together with the gland constitutes a stuffing-box. A projecting end of the arbor is provided with a hand-wheel b, and below which wheel there is fitted the hub of a depending bracket b^1, said bracket-hub being held in place by a nut b^2 in threaded engagement with said arbor end. The lower end of the bracket b^1 is also formed with a hub that serves as a bearing for an internally screw-threaded sleeve b^3, which sleeve is concentric with the arbor aforesaid and has secured thereto a thumb-nut b^4 at the lower face of the bearing-hub, the sleeve being held against vertical play by means of a flange-extension resting upon the upper face of said bearing-hub.

The arbor B is centrally bored for the reception of a pivot-post B^1, the upper end of which pivot-post projects beyond said arbor within the liquid-compartment of the compass-casing and terminates in a conical hardened steel needle-point B^2. The lower end of the pivot-post is in screw-threaded engagement with the sleeve b^3, there being a gland b^5 threaded into the adjacent end of the arbor. By the above construction leakage from the liquid-compartment is prevented through the central bore of said arbor, which construction at the same time permits vertical adjustment of the pivot-post. A compass-card C and its accompanying permanent magnet C^1 are suspended upon the needle-point B^2 by means of a metallic hood or cap c which cap is secured to the magnet and is provided with a concaved steel head c^1 adapted to receive said needle-point.

From the foregoing description it will be understood that the compass-card has free play upon its pivot, and also ample space in the liquid-compartment A^1 to permit of dip. The said compass-card is submerged

into any suitable liquid, non-conductive to an electric current and is provided with the usual cardinal points and sub-division markings. A stationary centrally apertured chart C^2 is secured to the outer walls of the compass-bowl to aid in setting the predetermined course of a craft or vessel, this chart being a minature duplicate of the compass-card, its marked points being visible through a central aperture of said compass-card.

A contact-finger or circuit-closer c^2 depends from the cap c of the compass-card, the contact-finger being arranged in the path of a pair of contact members or electrodes d, d^1, the latter having flared contact-faces between which the said contact-finger rests. These electrodes constitute terminals in connection with electric-circuits to be hereinafter described, said terminals being insulated from and carried by a collar d^2 secured to the upper end of the arbor. The collar d^2 also carries an index-pointer d^3 that serves as a guide in connection with the chart C^2 to facilitate setting the compass-mechanism for steering in any desired course of a craft. The terminals d and d^1 are connected by wires 1 and 2, which wires pass through insulated apertures in the arbor B. The circuits which control said steering-gear are respectively closed by means of the contact-finger c^2 engaging either of the electrodes d d^1, there being a conductor-wire 3 common to both circuits connected to a binding-post d^2. The electric-current passing from contact-finger c^2 through the cap c, pivot-post B^1, arbor B, and cap a^1 to the binding-post d^2, which post is seated into said cap.

The flared contact-faces of the electrodes are provided in order to give more or less play of the contact-finger c^2, depending upon the weather condition of the sea, if for instance, it is calm the compass-card would be lowered by the pivot-post so as to reduce the play of said finger between the electrodes to a minimum, while if the opposite weather condition exists, the aforesaid finger would be raised accordingly, thus controlling and preventing undue throwing in or out of the steering-gear through premature closing of the electric circuits and a consequent wabble of the vessel. The above mentioned raising or lowering of the pivot-post is accomplished through revolving the threaded sleeve b^3 in connection therewith. This sleeve is also revolved to raise the compass-card and its contact-finger c^2, in order that the latter may be entirely disengaged from the electrodes when it is desired to set a vessel upon its course, in which case after disengaging the posts the vessel is thereafter set in the usual manner, said vessel in effect turning upon the pivot-post of the compass, while the compass-card and its magnet will remain stationary, pointing on a north and south line. The arbor is then revolved by means of its hand-wheel b until the flared contact-faces of the electrodes are brought to a point alined with the contact finger c^2 but below the same, in which position the pivot-post B^1 is lowered as previously described, so as to bring said finger on a horizontal plane within the oscillating path of the electrodes, as shown in Fig. 2, it being understood that these electrodes travel in an arc described around the pivot-point of the compass-card with any sheer of the vessel to port or star-board, the position of the card remaining constant owing to its permanent magnet.

Referring to the diagram view, Fig. 4, D indicates a vessel rudder in gear-connection with an electric-motor D^1. The rudder-stem D^2 has secured thereto and insulated therefrom a metallic indicator-arm f, which arm is alined with said rudder and adapted to swing in union therewith. The free end of the arm f is normally midway between a pair of adjustable metallic quadrant plates f^1, f^2, either one of which plates is adapted to engage the said free end of the arm when the vessel-rudder is moved from its fore-and-aft position. The position of the quadrant plates may be circumferentially changed when desired to maintain their relative location to the indicator-arm f, by means of spindles f^3, which spindles are swiveled in blocks f^4, their ends being in screw-threaded engagement with the quadrant plates.

The above described mechanism constitutes a "tell-tale," the arm f indicating at a glance the exact position of the rudder, which rudder if brought out of its true course will be automatically returned at the proper time through a reversal of the motor, caused by closure of an electric-circuit due to contact of arm f with one of the quadrant plates. In practice, it is a well known fact that vessels have more or less tendency to run to star-board or port and hence it rarely occurs that the rudder can be set to a true course. This is also the case where tide and weather conditions are taken into consideration.

In order to guard against any disturbance of the compass caused through the electric current that passes therethrough when a circuit is closed by either of the electrodes, I have provided a step-by-step or relay system of switches whereby a local circuit having a battery of slight strength at first utilized to actuate a delicate switch by means of magnets, which switch in turn closes a main battery circuit of much greater energy that acts directly upon magnets of a second switch to close the motor-circuit.

With the above objects in view I provide oppositely disposed magnets E, E^1, having

a common armature E^2, composed of a central metallic strip g, which strip is insulated from a pair of outer contact strips g^1, g^2, that are merged together at the fulcrum-point of the armature to form a spring finger that is fast in a post. The said armature is normally held away from either magnet in a central position by the spring-finger, in which position the free end of central armature strip g contacts with a binding-post g^5, the contact-strips g^1, g^2, being adapted to engage binding-posts g^3, g^4, respectively.

The motor-controlling switch comprises a pair of oppositely disposed magnets F, F^1, having a common armature comprising a fiber block, carrying armature plates F^2 and four contact plates h, h^1, h^2, h^3, these plates being diagonally connected by conductor-wires h^4, h^5. These contact plates are provided for alternately closing and reversing the circuit of the steering-gear motor D^1, by engaging binding-posts h^6, h^7, and h^8, h^9, when the armature is driven in either direction by the magnets F F^2 if energized.

Conductor wires 1 and 2 of the local or compass-controlled circuits are connected to magnets E, E^1, respectively, while wire 3 is connected to a local battery G and from thence to both magnets. The motor reversing circuit is connected by a wire 4 from armature strip g to the indicator-arm f, the circuit being completed by the arm either through quadrant plate f^1 or f^2 by conductor wires 4, 5, 6, which connect the quadrant plates f^1, f^2 with binding-posts g^5 and g^4. These posts are also connected by wires 7 and 8 to the magnets F, F^1, which magnets are connected by wire 9 to a main battery H, which battery is also connected by a wire 11 to the binding-post g^3, there being another wire 14 leading from said binding-post g^3 to the strips g^1, g^2 of the armature E^2.

The line wires X, Y of the motor circuit are connected to the contacting plates h, h^2, respectively, the said plates being arranged to contact with the binding-posts h^6 h^8. These binding-posts are connected by a branched wire 12 to one of the motor brushes, the opposite motor brush being connected by a wire 13 to binding-posts h^7, h^9, of the motor switch.

As shown in the diagram view, the compass A is illustrated as having its contact-finger c^2 in section and directly connected to wire 3, the electrodes d, d^1, which are disposed at either side of the finger being directly connected to wires 1 and 2. This distortion of the mechanical details is resorted to for the purpose of more clearly tracing the circuits. Assuming the apparatus as illustrated in the diagram view to be set for the course of a vessel due north, should the vessel sheer to star-board, it will cause electrode d to oscillate and thereby make contact with finger c^2. The local circuit is now closed, the current flowing from battery G over wire 3 to magnet E and back over wire 1 to the electrode d. The now energized magnet E will cause its armature to make contact between strip g^1 and binding-post g^5 thereby closing the main circuit from battery H over wire 9 to magnet F of the motor switch, completing the circuit through wire 7 to binding-post g^5, strip g^1 and the loop wire 14 connecting this strip to post g^3 and battery H over wire 11. The motor switch armature is now drawn over by energized magnet F and closes the motor-circuit through binding-posts h^6 and h^7, which are respectively connected to feed-wires 12 and 13, the line wires X, Y, being as previously stated connected to the plates of the armature which engage the binding-posts h^6, h^7. The energized motor causes the rudder together with its indicator-arm f to swing to port, as indicated by dotted lines, sufficient to start the vessel back on her true-course. The indicator-arm is now in contact with quadrant plate f^1, and the rudder will continue to move slowly in the direction mentioned until such time as the vessel has sheered back to her true course sufficiently to break contact between electrode d and contact-finger c^2. When said contact is broken, the spring portion of the armature E^2 causes the same to assume its normal central position, this action immediately closes the reversing circuit which travels in the following course. Starting with battery H the current passes over wire 9 to magnet F, thence by wires 8 and 5 to quadrant plate f^1 through indicator-arm f, wire 4 to the central strip g of armature E^2 and back to battery H through contact-post g^3 and wire 11. The energizing motor switch magnet F now draws its armature over thereby making contact with posts h^8 and h^9. This directs the current from line wire X over wire h^5 to binding-post h^9 and wire 13 to the motor, returning through wire 12 binding-post h^8 and out over the line wire Y, the motor is thus reversed and will quickly restore the rudder to its fore-and-aft position, it being understood that when the circuit is broken in either of the motor-switch magnets, the armature thereof will assume a neutral central position through spring-connection F^3 as shown.

One complete method of wiring for obtaining the desired electric circuits necessary in the operation of my invention is described, it being understood that the same may be varied in accordance with well known principles of electric engineering and I therefore do not wish to limit my invention to the arrangement of circuits herein shown and described.

While I have shown and described the compass-mechanism as operating to close

circuits increasing in strength by steps in order to actuate a rudder, it will be readily seen that in applying the apparatus to torpedoes or light crafts the armature E^2 may be connected to the rudder, in which case the magnets $E \cdot E^1$ would actuate the same, the spring-finger extension of said armature serving as a motor in opposition to the magnetic force of said magnets to cause a return of said rudder to a fore-and-aft position.

The essential elements of the invention in all instances is the depending contact-arrangement in connection with a permanent magnet whereby the contacting-members are constantly within a common plane so as to be engaged by oscillation of the member or members not carried by the magnet. By this construction the normal position of the magnet is not disturbed and the action of the apparatus becomes entirely automatic and not dependent upon any timed mechanism to ascertain the true course of the vessel.

I claim:

1. A magnetic steering apparatus comprising a liquid containing bowl, a rotatorily adjustable hollow arbor extending into the bowl, a pair of electrodes carried by the arbor, a pivot-post mounted in the hollow arbor, a permanent magnet provided with a compass card mounted upon the end of the pivot-post within the liquid containing bowl, a contact finger carried thereby arranged to engage either one of the electrodes, means for varying the relative vertical position of the finger and electrodes, a steering gear, a motor therefor, and an electric circuit having terminals connecting the electrodes and contact finger for controlling the steering gear motor.

2. A magnetic steering apparatus comprising a compass having a make and break mechanism, a steering gear, a motor therefor, an electric controlling circuit for the motor, a motor-controlling switch in the circuit, a magnetically-controlled relay switch, a local circuit connecting the make and break mechanism of the compass and relay switch, a make and break indicator mechanism in connection with the steering gear, and a motor-reversing circuit connecting the make and break indicator mechanism, relay switch and motor controlling switch, whereby said motor is reversed incidental to opening the local circuit by the compass carried make and break mechanism.

3. A magnetic steering apparatus comprising a mariner's compass having a card and attached magnet, a pivot-post for the card, a contact finger carried by said card, a pair of electrodes normally disposed in the path of travel of the contact finger, means for effecting rotatory adjustment of the electrodes, means for effecting disengagement of said electrodes from their normal contact relation with the contact finger, a steering gear, an indicator arm in connection therewith, contact plates disposed in the path of travel of the indicator arm, an electric motor for the steering gear, a motor circuit, a motor-controlling magnetic switch for the circuit, a local circuit in connection with the controlling switch of the motor circuit, the local circuit being under control of the electrodes and contact finger of the compass, a magnetically controlled relay switch in the local circuit, and conductors connecting the motor-controlling switch, relay switch, indicator arm and its contact plates, whereby the motor is reversed incidental to a break in the local circuit when the indicator arm is in contact with either one of its contact plates.

4. A magnetic steering apparatus comprising a compass having a circuit-closing mechanism, a motor, a steering gear in connection with the motor, an indicator arm carried by the steering gear, contact plates arranged in the path of travel of the indicator arm, a motor circuit, a magnetically-controlled motor switch for the motor circuit, a motor switch circuit, a local circuit in connection with the circuit-closing mechanism of the compass, a magnetically controlled relay switch in the local circuit, and conductors in connection with the indicator arm, its contact plates, motor-switch and magnetically controlled relay switch whereby the motor circuit current is reversed incidental to a break in the local circuit through the compass circuit-closing mechanism.

5. A magnetic steering apparatus comprising a mariner's compass having a card and attached magnet, a cap carried by the card, a pivot-post for the cap, a contact finger extending from the cap, a pair of adjustable electrodes normally disposed in the path of travel of the contact finger, a steering gear, an indicator arm carried thereby, contact plates disposed in the path of travel of the indicator arm, an electric motor for the steering gear, a relay armature provided with insulated outer contact strips, magnets disposed upon opposite sides of the armature, a local circuit connecting the magnets, electrodes and contact finger of the compass, a contact post arranged to normally engage the armature, other contact posts disposed upon opposite sides of the armature adapted to be engaged by the outer contact strips thereof, a main battery connecting that contact post which normally engages the armature, a conductor connecting said posts and outer contact strips of the armature, a conductor connecting the armature and indicator arm, conductors connecting the indicator contact plates and contact posts upon opposite sides of the armature, a motor-controlling switch comprising an armature having oppositely disposed pairs of contact

plates, the plates of each pair being cross-connected to the opposite pair, magnets for controlling the armature, conductors connecting the magnets and main battery, other conductors connecting the magnets and contact posts upon opposite sides of the relay switch armature, a binding-post for each contact plate of the motor-controlling armature, a conductor connecting each pair of the binding-posts with the motor, and line wires connecting one pair of the contact plates of said motor-controlling armature.

6. A magnetic steering system comprising a permanent magnet, a pivot post for the magnet, a pair of electrodes rotatorily adjustable about the pivot post, a circuit closer depending from the magnet constantly in the path of travel of the electrodes, and an electric circuit for the steering gear connecting the electrodes and said circuit closer.

7. In a magnetic steering apparatus; the combination of a permanent magnet, a pivot-post therefor, a finger carried by the magnet, a pair of electrodes having vertically disposed flared contact faces adapted to be engaged by the finger, and means for varying the relative vertical position of the finger and electrodes.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

AUGUST T. NELSON.

Witnesses:
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E. C. SCHNECK.