Sept. 7, 1948. G. W. CRISE 2,448,778

AUTOMATIC BOAT-STEERING MECHANISM

Filed Nov. 23, 1944

Fig. 2.

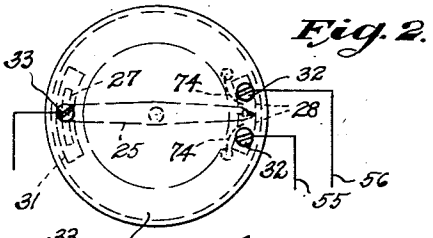


Fig. 1.

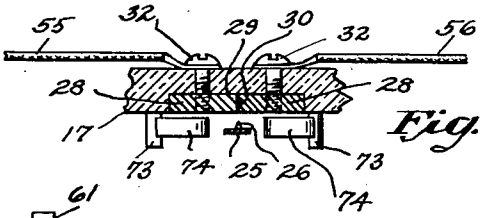


Fig. 4.

Fig. 3.

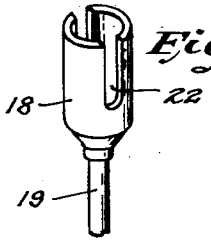
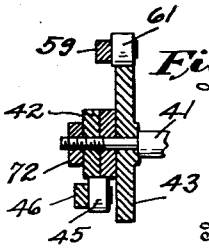


Fig. 5.



Inventor
George W. Crise

By N. D. McDowell

Attorney

Patented Sept. 7, 1948

2,448,778

UNITED STATES PATENT OFFICE

2,448,778

AUTOMATIC BOAT-STEERING MECHANISM

George W. Crise, Columbus, Ohio

Application November 23, 1944, Serial No. 564,828

9 Claims. (Cl. 318—489)

1

This invention relates to automatic steering means for boats, and its principal object is to provide an automatic means, responsive to variations of a magnetic compass needle for maintaining a boat on a given course.

Automatic steering mechanism for this purpose of prior designs is structurally complicated and costly to install, inasmuch as such prior apparatus is usually controlled by gyroscopic means or in another form utilizes electronic tube apparatus and light-sensitive devices. In brief, such prior apparatus is used primarily on large ships or vessels and is ordinarily incapable of being structurally simplified to permit of proper usage thereof on small privately owned motor boats, sailing craft, etc.

Accordingly, it is the aim of the present invention to provide simplified automatic steering mechanism adapted for popular usage on small water craft and wherein the power required to actuate the apparatus may be obtained from standard storage batteries, such as those commonly used in connection with the engine starting and lighting systems of popularly priced, privately owned motor boats.

For a further understanding of the invention, reference is to be had to the following description and the accompanying drawing, wherein:

Fig. 1 is a diagrammatic view, partly in side elevation and vertical section, of my improved automatic boat steering mechanism;

Fig. 2 is a plan view of the compass casing;

Fig. 3 is a detail perspective view of the upper end of the compass needle elevating stem;

Fig. 4 is a fragmentary vertical sectional view taken on the plane indicated on the line 4—4 of Fig. 1.

Fig. 5 is a fragmentary sectional view taken on the plane of the line 5—5 of Fig. 1.

Referring more particularly to the drawings, the numeral 5 designates the steering wheel or helm of a boat, the same being employed to operate the boat rudder, not shown, through the usual interrelated controls. To the radiating spokes of this wheel, there is secured as at 6 a belt ring 7, and over this ring there is passed an endless belt, or other equivalent power transmitter 8. Also, the belt is trained over a sheave 9 rotatably mounted on the armature shaft 10 of a reversible electrical motor 11. The ring 7 is detachably connected with the helm so that the latter may be either manually or automatically rotated.

The split field 12 of the motor has two opposing coils 13 and 14 which, through selective excita-

2

tion, cause the armature shaft of the motor to rotate in opposed directions. In connection with this motor, the present invention utilizes compass governed circuit-controlling apparatus which functions to produce, first, rotation of the motor shaft in one direction so that the steering wheel 5 of the boat and its associated rudder will be turned to produce a desired change in the course the boat is following. However, the rotation of the motor in this first direction is necessarily greater than that which is desired. To alter the course or heading of the boat, as is common in the steering of smaller boats, a correction is made, as is usually done when manually steered by immediately thereafter reversing the direction of rotation of the helm, in this case by reversing the direction of the rotation of the motor 11, in order to bring the steering wheel back to its original heading, or only partially so, as may be desired.

Therefore, in accordance with the present invention, my improved apparatus functions to rotate the steering wheel first in one direction and immediately thereafter in the opposite direction whereby due compensation is made in the course which the boat is to pursue.

In attaining this end, use is made of a compass casing comprising a base section 15 having an annular upstanding side wall 16, and on the upper edges of which wall there is seated a rotatably adjustable cover section 17, the outer margins of said cover section being provided with degree graduations of a full circle. The base section is formed axially with an opening in which is slidably mounted a sleeve 18 fixed to the upper end of a stem 19, the lower end of said stem being formed with the core 20 situated for travel within the field coil 21 of a solenoid 8. The sleeve 18 is vertically slotted as at 22 to receive a bridge member 23 which forms a stationary part of the base section 15. Centrally, this bridge member is provided with an upstanding bearing point 24, and on the bearing point there is mounted for turning movement a liftable magnetic needle 25.

At one end, the needle 25 carries a conical contact 26 and, at its other end, on the opposite side of the point 24, is a transversely disposed contact bar 27. The cover section 17, which is usually formed from a transparent dielectric material, is provided with a pair of fixed arcuate contacts 28, the latter being seated in a socket 29 formed in the cover section, so that the lower surfaces of the contacts 28 will lie in a horizontal plane flush with that of the lower or inner surface of said cover section. A thin strip of Bakelite, or other insulating material 30, is placed between the con-

tacts 28 to electrically separate the same and yet maintain close spacing thereof. On the opposite side of the cover section 17, there is provided a single arcuate contact element 31 which is adapted to be brought into engagement with the bar 27 when the needle 25 is elevated by the excitation of the solenoid coil 21 simultaneously with the engagement of the conical contact 26 of the needle 25 with one or the other of the arcuate contacts 28.

The contacts 28 are provided with terminal screws 32, while the contact element 31 is provided with a single terminal screw 33, the headed ends of said screws being accessible from the top of the compass casing.

As a source of electrical energy, I employ a standard storage battery B of from 6 to 10 volt capacity. Leading from the positive terminal of this battery is a conductor 34 which extends to one terminal of a small direct current motor 35. A second conductor 36 extends from the other terminal of this motor back to the negative side of the battery B, thus completing the circuit of the motor 35 to maintain the same in constant operation as long as the hand switch 37 remains closed. The armature shaft 38 of the motor 35 is provided with a worm 39 which meshes with a worm gear 40 fixed on the rotating operating shaft 41 of a timer mechanism T.

Rotatable with the shaft 41 is a cam 42 and, also, mounted on the shaft 41 is a second cam 43. The lifting face 44 of the cam 42 is disposed, during rotation of the shaft 41, for engagement with a roller 45 carried on one end of an arm 46. The intermediate portion of this arm is pivoted as at 47 to the frame 48 of a reversing switch R. The end of the arm 46 opposite to that carrying the roller 45 is provided with a suitably insulated resilient strip 49 which carries at its outer end a contact 50, the latter being united by an extensible conductor 51 with the conductor 36.

It will be seen that when the face 44 of the cam 42 contacts the roller 45, the arm 46 will be oscillated about its pivot 47 to elevate the strip 49, thus bringing the contact 50 of said strip into engagement with an adjustable contact screw 52 carried by the frame 48 of the reversing switch.

The screw 52 is joined by a conductor 53 with one side of the coil 21 of the solenoid S, while the other side of the coil 21 is joined by a conductor 54 with the battery conductor 34, thus energizing the solenoid circuit and creating a magnetic field which draws the core 20 of the solenoid upwardly, carrying with it the stem 19 and the sleeve 18, so that the magnetic needle is lifted and brought into engagement with one or the other of the arcuate contacts 28 and the stationary contact element 31.

A conductor 34*a* extends from the conductor 34 to the terminal screw 33 of the contact element 31, while leading from the terminal screws 32 of the arcuate contacts 28 are conductors 55 and 56. These conductors lead to contact elements 57 and 58, respectively, which are carried by a suitably insulated rocker arm 59, the latter being intermediately pivoted as at 60 on the frame 48 of the reversing switch. The outer end of the arm 59 carries a roller 61 which rides on the peripheral edge of the cam 43. When the roller 61 is in engagement with the lift region 62 of the cam 43, the contacts 57 and 58 are maintained in engagement with the upper ends of a pair of contact screws 63 and 64 of the insulated frame 48.

When the roller 61 is in engagement with the depressed or dwell portion 65 of the cam 43, the contacts 57 and 58, by gravitational or spring action on the part of the arm 59, are maintained in engagement with the lower ends of a second pair of contact screws 66 and 67 on the frame 48. The screws 64 and 66 are joined with conductors 68 which lead to the field coil 13 of the motor 11, while the screws 63 and 67 are connected with conductors 69 which lead to the field coil 14 of the motor 11.

In the operation of the apparatus, the switch 37 is closed to energize the motor 35, thereby causing timed rotation of the shaft 41. When the face 44 of the cam 42 contacts the roller 45 on the outer end of the arm 46, the latter is lifted to bring the contact 50 into engagement with the frame-carried screw 52, thus completing the circuit of the solenoid coil 21 and elevating the core 20 and the associated stem 19 so that the magnetic needle 25 is raised, bringing the conical contact 26 thereon into engagement with one or the other of the arcuate contacts 28, and the bar 27 of said needle into engagement with the contact element 31. This permits current to travel by way of the conductor 34*a* to the contact element 31, thence through the needle 25 to, for example, the contact 28 with which is connected the conductor 55.

Further assuming that the parts are in the position disclosed in Fig. 1, current will travel from the conductor 55 through the contact 57, terminal screw 63, conductor 69 to the coil 14, passing from said coil by way of a conductor 70 through the commutator 71 of the motor 11 and thence by way of the conductor 36*a* and conductor 36 to the return side of the storage battery. This excitation of the motor 11 causes its rotation in one direction, revolving with it the steering wheel 5 of the boat.

The rotation of the motor 11 in the first direction is continued until the roller 61 on the rocker arm 59 drops into the dwell portion 65 of the cam 43, whereby the rocker arm, by gravity or spring action, is oscillated so that the contacts 57 and 58 are moved out of engagement with the ends of the terminal screws 63 and 64 and brought into engagement with the ends of the terminal screws 66 and 67. If current is passing through the conductor 55, as we have assumed, it will then pass through the conductor 68 to the coil 13 of the motor 11, thereby changing its polarity to reverse the direction of rotation of its armature 10 and producing a corresponding change in direction of rotation of the steering wheel 5, in order to bring the rudder back to its straight ahead or original course position, or partially so.

This rotation is continued until the lifting face 44 of the cam 42 is freed from engagement with the roller 45 of the arm 46. When so freed, the arm 46 by gravity or by spring action, drops and breaks the circuit to the solenoid S so that the compass needle is lowered and the circuit to the motor 11 interrupted. The cams 42 and 43 may be relatively adjusted, through the actuation of the threaded thumb nut 72 on the shaft 41, so that the cam 43 will reverse the direction of rotation of the steering motor 11 at any predetermined time relation with respect to the cam 42, thereby causing the steering motor to turn the wheel 5 and then return the wheel to its original dead-ahead position, or to return it only part way, as may be desired.

The rotatable cover section of the compass needle casing is provided with spaced depending studs 73. These studs carry resilient strips 74

of Vinylite or the like which serve to yieldably arrest deflection of the energized needle.

I claim:

1. Automatic boat-steering mechanism comprising a reversible steering control-operating motor having a pair of polarity-changing field coils, a compass switch for governing selectively the excitation of said field coils, said switch embodying a casing having mounted therein a pivotally movable north-seeking magnetic needle, a stationary contact on said casing engageable with one end of said needle, a pair of electrically spaced stationary contacts carried by said casing and engageable with the other end of said needle, a support for said needle normally maintaining the latter out of engagement with said contacts, conductors leading from said pair of contacts to said field coils, a return conductor leading from said motor to a source of electrical energy, a conductor extending from said energy source to said single stationary contact, electrical means operable when energized to actuate said needle support to bring said needle into circuit-completing engagement with a pair of said contacts with which the needle registers immediately prior to such engagement, a circuit for the electrical means actuating the needle support, and a timing switch for intermittently opening and closing said last-named circuit.

2. Automatic boat-steering mechanism comprising a reversible steering control-operating motor having a pair of polarity-changing field coils, a compass switch for governing selectively the excitation of said field coils, said switch embodying a casing having mounted therein a pivotally movable north-seeking magnetic needle, a stationary contact on said casing engageable with one end of said needle, a pair of electrically spaced stationary contacts carried by said casing and engageable with the other end of said needle, a support for said needle normally maintaining the latter out of engagement with said contacts, conductors leading from said pair of contacts to said field coils, a return conductor leading from said motor to a source of electrical energy, a conductor extending from said energy source to said single stationary contact, electrical means operable when energized to actuate said needle support to bring said needle into circuit-completing engagement with a pair of said contacts with which the needle registers immediately prior to such engagement, a circuit for the electrical means actuating the needle support, a timing switch for intermittently opening and closing said last-named circuit, and a reversing switch actuated by said timing mechanism for alternately energizing the field coils of said motor while the compass switch needle maintains a given position of circuit closure.

3. Automatic steering mechanism for marine craft comprising a reversible steering control-operating electric motor, the latter being provided with a pair of polarity-changing field coils, a compass switch for governing the controlled excitation of said coils, said switch embodying a casing comprising a base and a contact-carrying member adjustably mounted on said base, a magnetic north-seeking needle pivotally mounted for turning movement in said casing, a stationary contact on said casing member engageable with one end of said needle, a pair of electrically spaced stationary contacts carried by said casing and engageable with the other end of said needle, a movable support for said needle normally maintaining the latter out of engagement with said contacts, a conductor leading from each of said pair of contacts to one of said field coils, a return conductor leading from said motor to a source of electrical energy, a conductor extending from said energy source to the single stationary contact, a solenoid operative when energized to actuate said needle support to advance said needle into circuit-completing engagement with a pair of said contacts with which the needle registered immediately prior to the energizing of the solenoid, an operating circuit for said solenoid including said energy source, and a periodically operating switch in said solenoid circuit for intermittently energizing and deenergizing the solenoid.

4. Automatic steering mechanism for marine craft comprising a reversible steering control-operating electric motor, the latter being provided with a pair of polarity-changing field coils, a compass switch for governing the controlled excitation of said coils, said switch embodying a casing comprising a base and a contact-carrying member adjustably mounted on said base, a magnetic north-seeking needle pivotally mounted for turning movement in said casing, a stationary contact on said casing member engageable with one end of said needle, a pair of electrically spaced stationary contacts carried by said casing and engageable with the other end of said needle, a movable support for said needle normally maintaining the latter out of engagement with said contacts, a conductor leading from each of said pair of contacts to one of said field coils, a return conductor leading from said motor to a source of electrical energy, a conductor extending from said energy source to the single stationary contact, a solenoid operative when energized to actuate said needle support to advance said needle into circuit-completing engagement with a pair of said contacts with which the needle registered immediately prior to the energizing of the solenoid, an operating circuit for said solenoid including said energy source, a periodically operating switch in said solenoid circuit for intermittently energizing and deenergizing the solenoid, and an intermittently operating reversing switch cooperative with the conductors leading from said compass switch to the field coils of said motor for alternating the excitation of said field coils when said motor circuit is closed by the operation of said magnetic switch.

5. A compass switch comprising a casing formed to include a base, a contact-carrying member rotatably mounted on said base, a needle support including a stem movably carried by said base, a north-seeking magnetic needle pivotally mounted for free turning movement on said needle support, a relatively stationary contact on said adjustable casing member adapted for engagement with one end of said needle, a pair of electrically spaced contacts carried by said adjustable member engageable with the other end of said needle, a solenoid cooperative with the stem of said needle support and operable when energized to advance said needle into circuit-completing engagement with a pair of said contacts with which the needle registered immediately prior to the energizing of the solenoid, an operating circuit for said solenoid including a source of electrical energy, and a periodically operating switch mechanism for intermittently opening and closing said solenoid circuit.

6. In boat-steering mechanism, a reversible control-operating electric motor having a pair of polarity-changing field coils, an operating circuit

for said motor including a source of electrical energy, a compass switch positioned in said circuit, said switch including a movably mounted north-seeking magnetic needle, a timing mechanism embodying an electric motor, a circuit for the timing motor leading to said energy source, rotatable primary and secondary cam elements driven by said timing motor, a movable switch arm carrying a pair of spaced contacts cooperative with said primary cam element to alternately energize the field coils of said reversible motor at timed intervals, a second movable switch arm engageable with said secondary cam element for bringing the same into and out of engagement with a stationary contact, solenoid means operable when energized to advance the needle of said compass into a position of circuit closure, and a circuit for said solenoid means opened and closed by the movement of said second switch arm.

7. In an automatic course-maintaining apparatus for rudder equipped craft, a reversible electric motor for governing the operating positions of the rudder of such a craft, said motor having a pair of polarity-changing field coils, an operating circuit for said motor including a source of electrical energy, a compass switch positioned in said circuit, said switch including a movably mounted north-seeking magnetic needle, a timing mechanism embodying an electric motor, a circuit for the timing motor leading to said energy source, primary and secondary cam elements rotatable unitarily about a common axis and driven by said timing motor, means providing for the adjustment of said cam elements axially with respect to each other and for maintaining their positions of relative adjustment, a movable switch arm carrying a pair of spaced contacts cooperative with said primary cam element to alternately energize the field coils of said reversible rudder motor at timed intervals, a second movable switch arm engageable with said secondary cam element for bringing the same into and out of engagement with a stationary contact, solenoid means operable when energized to advance the needle of said compass into a position of circuit closure, and a circuit for said solenoid means opened and closed by the movement of said second switch arm, the adjustment capacity of said cams being such as to cause the operation of said reversible motor to swing an associated rudder through a greater arc of movement in its course-corrective movement than in its return movement.

8. In an automatic steering system for dirigible craft, a reversible electric motor for actuating a swinging rudder of such a craft, an operating circuit for said motor, a north-seeking compass-actuated switching means positioned in said motor circuit, a motor reversing switch in said circuit, and motor driven means for actuating said reversing switch, said latter means including a pair of switch-actuating elements adapted for rotation in unison and adjustable with respect to each other to produce a longer period of rotation of said reversible motor in one rudder-actuating direction than in the other.

9. In an automatic course-maintaining apparatus for rudder equipped craft, a rudder control, a reversible electric motor for actuating said control, an operating circuit for said motor, a compass switch positioned in said circuit, said switch including a rotatably mounted and vertically movable north-seeking magnetic needle, spaced contacts carried by said switch and forming a part of said circuit, intermittently operated electro-responsive means for lifting said needle at predetermined intervals into positions of engagement with said contacts, and spaced yieldable means for limiting the oscillatory movement of said needle.

GEORGE W. CRISE.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,993,549	Holmes	Mar. 5, 1935
1,993,550	Holmes	Mar. 5, 1935