No. 622,398. Patented Apr. 4, 1899.

# G. SAUTTER.

## ELECTRIC STEERING APPARATUS FOR VESSELS.

(Application filed Nov. 17, 1898.)

(No Model.)

Fig. 3.

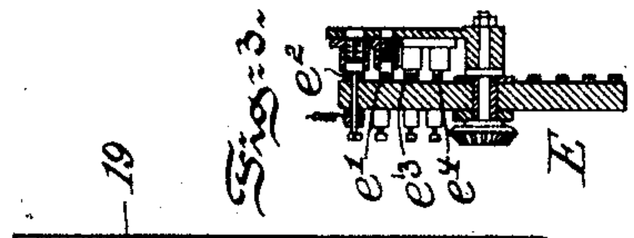


Fig. 1.




Fig. 2.


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# UNITED STATES PATENT OFFICE.

GASTON SAUTTER, OF PARIS, FRANCE.

## ELECTRIC STEERING APPARATUS FOR VESSELS.

SPECIFICATION forming part of Letters Patent No. 622,398, dated April 4, 1899.

Application filed November 17, 1898. Serial No. 696,683. (No model.)

*To all whom it may concern:*

Be it known that I, GASTON SAUTTER, a citizen of the Republic of France, residing at Paris, France, have invented certain new and useful Improvements in Electric Steering Apparatus for Vessels, of which the following is a specification.

My invention has relation to a steering apparatus for vessels, and in such connection it relates to the construction and arrangement of such an apparatus.

The principal object of my invention is to provide a steering apparatus for vessels in which the rudder is directly actuated by means of an electromotor without the intervention of a steam-engine and motor controlled thereby.

My invention, stated in general terms, consists of an electric steering apparatus for vessels constructed and arranged in substantially the manner hereinafter described and claimed.

The nature and scope of my invention will be more fully understood from the following description taken in connection with the accompanying drawings, forming part hereof, and in which—

Figure 1 is a diagrammatic view of an apparatus embodying main features of my invention, certain portions of said apparatus being shown in section. Fig. 2 is a cross-sectional view of the transmitter forming a part of the apparatus, and Fig. 3 is a cross-sectional view of the commutator-rheostat, also forming part of said apparatus.

Referring to the drawings, A represents the transmitter, consisting, essentially, of a controlling-lever A′, having two branches, one branch carrying a spring-contact $a^4$, bearing upon the various contact-points $a'$ $a^2$, whereas the other branch is also provided with a similar spring-contact $a^5$, bearing upon the segmental contact-plate $a$. The controlling-lever A′, actuated by the operator, establishes the positive pole of a source of energy with any one of the said contacts. The contacts $a^2$ are intended for turning the rudder toward the right side, while the contacts $a'$ are for turning the rudder toward the left. A series of connecting-strips unite each contact $a'$ and $a^2$ of the transmitter A to each of the contacts $b'$ and $b^2$ of the receiver B. A metallic contact-rod C is located and adapted to be moved in front of the receiver B. This rod C is provided with an insulated surface $c$, adapted to interrupt or allow the current to pass as it arrives at one of the contacts $b'$ or $b^2$ of the receiver whenever the contact-rod C is or is not in connection with the contact $b'$ or $b^2$. The diagram clearly shows how the current passes by means of the spring-contacts carried by the receiver B. The contact-rod C is mechanically connected by means of a screw $j$ and gear-wheel H with the principal motor M operating the rudders. An auxiliary motor M′, fed intermediately through a system of commutators having electromagnetic relays R′ and $R^2$, gives power to the rheostat and commutator E of the principal motor. The commutator-rheostat E consists of four parts $e^4$, $e^4$, $e^5$, and $e^5$, each of which communicates with a section of a rheostat, as illustrated in Fig. 1 of the drawings. The apparatus is also provided with three circular plates or metallic rings $e'$, $e^2$, and $e^3$. The ring $e'$ communicates by wire 20 20 with the positive pole of the source of energy, and the ring $e^3$ by conductors 18 17 communicates with one of the brushes of the principal motor M. The ring $e^2$ communicates by wire 21 21 with one of the poles of a relay $R^4$. The principal motor M is provided with two relays $R^3$ and $R^4$, which are intended to operate the commutators which permit the current to traverse the motor M in one direction or the other, so as to cause it to rotate correspondingly.

The construction and arrangement of the electromagnetic relays R′, $R^2$, $R^3$, and $R^4$ are the same as described in Letters Patent No. 553,819, granted to myself and J. M. L. Savatier and C. E. De Lagarbe under date of January 28, 1896, and they consist, essentially, of an electromagnet actuated by a current taken in derivation from the source of energy and in which the armatures by closing upon the electromagnet constitute commutators and either establish or cut off the communication between the circuit of the motor and its source of energy. The shaft of the auxiliary motor M′ imparts motion to the shaft K of the commutator E by means of an epicycloidal train of conical gear-wheels adapted to receive its movement through a pinion G, actuated by the principal motor M. This

train of conical gears consists, essentially, of a gear-wheel $g'$, operated by a pinion G. This wheel $g'$ carries in its interior two axles, upon which rotate two bevel-pinions $g^2$. These two pinions gear with two bevel-gears $g^3$ and $g^4$. The bevel-wheel $g^4$ is keyed to the shaft K of the commutator E. The main wheel $g'$ is loose upon the axle of the system. From the foregoing description it will be understood that in this differential train if the wheel $g'$ is stationary in space and the wheel $g^3$ alone be rotated by the motor M' the wheel $g^4$ will rotate in a direction opposite to that of the gear $g^3$ and with the same speed. If the wheel $g'$ is rotated by the pinion G in either one direction or the other, it will accelerate or diminish the rotation of the wheel $g^4$ relatively to that of the wheel $g^3$. It will therefore be observed that the combination of rotations produced by the wheels $g'$ and $g^2$ will cause a rotation of the wheel $g^4$ and axle of the auxiliary motor M', or in an opposite direction, or no rotation. The current traversing the transmitter A and receiver B is only for operating the relays R' and $R^2$—that is, to open or close the system of induction of the motor M'. The relay R' is intended to turn the rudder toward the left and the relay $R^2$ to turn it toward the right.

The excitation of the motors M and M' is independent and is by preference controlled from the original electric source of energy.

In the operation of the apparatus when the transmitter-lever A' is displaced from its position of rest and is, as illustrated in the diagram, upon one of the contacts $a^2$ the current of the positive pole of the source of energy will pass by the wires 1 and 2 to the plate $a$, always in contact with the lever A', and through the said lever to one of the contacts $a^2$. This contact $a^3$ is connected, as are all the other adjacent contacts, by means of wires 1' and 2', with the corresponding contact $b^2$ of the receiver B in communication with the positive pole of the source of energy. From the contact $b^2$ the current is adapted to pass through intermediate contacts in the diagram to the conductor-rod C, connected by means of the wires 3 and 4 with the relay R'. The magnetic relay becoming energized closes its armature and establishes the corresponding contacts indicated by the small squares on the diagram. The current crosses the relay and returns to the negative pole of the source of energy by the conductors 5 and 6. The relay R' as soon as it is energized permits the current from the source of energy to cross the inductor of the auxiliary motor M'. In the diagram is indicated the path of the current. From the positive pole of the source of energy the current passes by the conductors 7 and 8, the commutator, a relay, and conductors 9, 10, and 11, entering the motor M', from which it passes by the wires 12, 13, and 14 to cross again the commutator having relays and returning by the wire 6 to the negative pole of the source of energy. The auxiliary motor M', which is then crossed by the current, begins to operate and throws into operation the principal motor M, and consequently the rudder. It will be understood, therefore, that the displacement of the lever A' starts in motion the principal motor M of the rudder through the intermediation of the motor M'. The shaft of the motor M' gives motion, as before explained, through a train of differential gears D to the commutator-rheostat E, which is traversed by the current of the principal motor. Inasmuch as the pinion G is operated directly by the motor M it results from the arrangement of the differential gears that the rotation of the axle of the commutator E will be the combination of rotations of the auxiliary motor M' and principal motor M and depending upon the two movements. When, therefore, the motor M' has been started by the displacement of the lever A' of the commutator A, the principal motor M being immovable the motor M' will rotate in the opposite direction the axle K of the commutator E by the motion of the differential train of gears hereinbefore explained. As soon as the handle of the commutator E has left its position of rest and has been moved, for example, to the right the current from the positive pole of the source of energy will pass by wires 20 20 to the circular plate or ring $e'$ and through the handle of the commutator-rheostat to the plate or ring $e^2$. It then passes over wires 21 21 and actuates the relay $R^4$ and returns by wires 5 5 6 6 to the negative pole of the source. The excitation of relay $R^4$ causes its armature to close and the positive current from the source will pass by wire 7 7 through the relay $R^4$ to wire 16, and thence to the armature of motor M, which is thereby caused to rotate in a corresponding direction. After issuing from the armature the current continues by the wire 17 18 to the circle $e^3$, and thence it passes through the handle of the commutator into one of the contact-points $e^5$. According to the position of this contact-point the current passes through the whole or through one part of the rheostat and passes again by the wire 19 19 to the magnetic relay $R^4$ and by 6 6 6 6 to the negative pole of the source. It can thus be seen that according to the action of the rheostat-commutator E the current traverses the armature of the motor M and causes it to rotate and that the strength of this current depends upon the portion of the rheostat that is interposed, which depends in its turn to the position of the contact-point $e^5$, upon which the lever of the commutator rests. The motor M therefore begins to rotate at first slowly, because the greater part of the rheostat of the commutator E is in circuit. In its movement the motor M rotates the rudder and it has a tendency to rotate it in the proper directions, and at the same time it operates upon the pinion G and through it the wheel $g'$. This wheel $g'$ is thus rotated in a direc-

tion contrary to the direction imparted by motor M′ to the differential train of gears. From the foregoing it will be understood that the motor M has therefore a tendency to neutralize the rotation of the axle K of the commutator E given by motor M′, and whichever motor rotates the faster its motion controls the movement of said axle K. While this takes place, the action of the motor M causes the rod C of the receiver B, through the intervention of the gear-wheel H and the endless screw *j*, to be displaced. This displacement of the said rod occurs until the insulated contact *c* is brought opposite the contact $b^2$. At this moment the current cannot further pass from the contact $b^2$ to the rod C and relay R′. The relay R′ then releases its armature and breaks the current from the auxiliary motor M′, which then stops. The principal motor, which is always fed, continues its rotation and as it is then alone operating upon the differential train of gears through the wheel *g*′ it turns the commutator E in an opposite direction to that which the motor M′ had previously imparted thereto. The commutator E while rotating brings its rheostat gradually back into circuit, the rotation of the motor M gradually diminishes, and it stops entirely when the flexible contact of the commutator E ceases to move. It will therefore be seen that the movement of the principal motor M depends, essentially, upon the movement of the auxiliary motor M′, which latter has always a tendency to rotate the commutator E to force out the rheostat, and consequently to accelerate the speed of the principal motor M. In contradistinction to this the principal motor M always has a tendency to retard the commutator of the rheostat E, and consequently to establish again the rheostat in circuit, which compels it to slow down, and thus to arrest itself. There is therefore a tendency for a constant equilibrium to be established between the action of the auxiliary motor M′ and that of the principal motor M. The speeds of these two motors have a tendency to exactly counterbalance each other until the principal motor interrupts the current of the auxiliary motor, when it brings back the insulated contact *c* opposite the active contact $b^2$. The movement of the rudder therefore stops precisely when the position of the motor M—that is, the rudder itself—corresponds to the contact $b^2$, which is the position of the lever of contact of the transmitter A. There is therefore potentially a mechanical connection between each of the positions of the motor and rudder—that is, of the rudder itself—and each one of the positions of the contact-rod C of the receiver—that is, of the transmitter itself. This mechanical transmission is calculated in such manner that the angle of the rudder corresponds precisely to the contacts $a^2$ and $b^2$.

A leading feature of my invention is that the number of rotations which the motor M of the rudder will make in one or other direction is forcibly or potentially limited, because the motor is mechanically attached to the rudder, which can turn only to a given maximum angle. Hence each one of the positions of the rudder must correspond to each one of the positions of the receiver B, and consequently of the transmitter A.

The rheostat-commutator E is divided into two series of contact-points $e^4$ $e^4$ $e^5$ $e^5$ to start toward the left and toward the right. Each one of the series of contact-points actuates one of the relays $R^3$ $R^4$, one for the right and one for the left, and between each of the contact-points is placed a section of the rheostat, as indicated in Fig. 1 of the drawings.

Having thus described the nature and object of my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In an electric steering apparatus, a transmitting apparatus, a series of commutators provided with electromagnetic relays or their equivalents controlled by the transmitting apparatus, an auxiliary motor, the circuit whereof is adapted to be opened and closed and its current reversed by said commutators and relays, a differential train of gearing controlled by said auxiliary motor, a rheostat and commutator controlled by said train of gearing, a principal motor controlled by said rheostat and commutator and directly controlling the rudder, and mechanism controlled by said principal motor and connecting the same with the train of gearing and with said transmitting apparatus, substantially as and for the purposes described.

2. In an electric steering apparatus, a transmitting apparatus, a series of commutators provided with magnetic relays or their equivalents controlled by the transmitting apparatus, an auxiliary motor, the circuit whereof is adapted to be opened and closed and its current reversed by said commutators and relays, a differential train of gearing controlled by said auxiliary motor, a rheostat and commutator controlled by said train of gearing, and a principal motor controlled by said rheostat and commutator and directly controlling the rudder, substantially as and for the purposes described.

In testimony whereof I have hereunto set my signature in the presence of two subscribing witnesses.

GASTON SAUTTER.

Witnesses:
PAUL DE MESTRAL,
J. ALLISON BOWEN.