No. 660,156. Patented Oct. 23, 1900.

B. A. FISKE.

METHOD OF CONTROLLING MOVING VESSELS OR VEHICLES.

(Application filed Apr. 2, 1900.)

(No Model.)

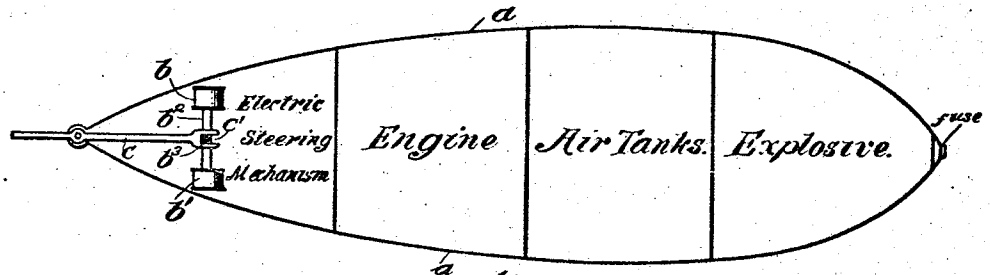

Fig. 1.

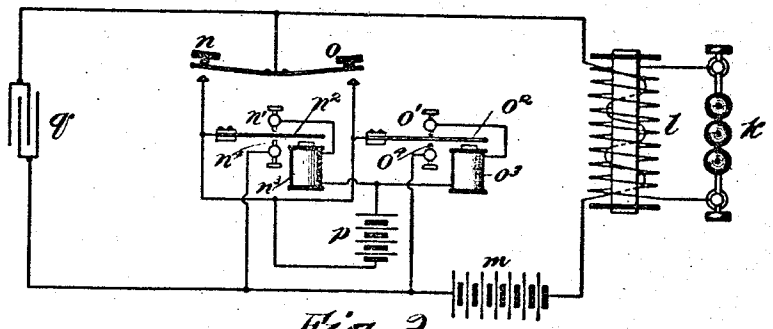

Fig. 2.

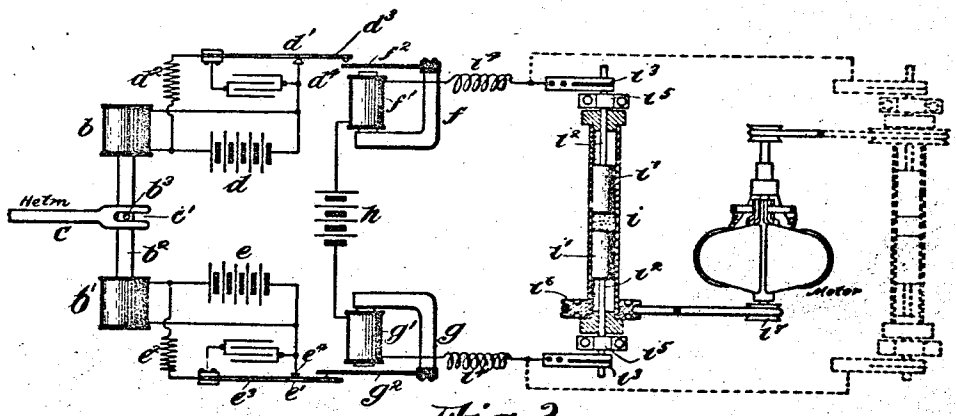

Fig. 3.

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UNITED STATES PATENT OFFICE.

BRADLEY A. FISKE, OF THE UNITED STATES NAVY, ASSIGNOR TO THE WESTERN ELECTRIC COMPANY, OF CHICAGO, ILLINOIS.

METHOD OF CONTROLLING MOVING VESSELS OR VEHICLES.

SPECIFICATION forming part of Letters Patent No. 660,156, dated October 23, 1900.

Original application filed September 7, 1898, Serial No. 690,433. Divided and this application filed April 2, 1900. Serial No. 11,043. (No model.)

To all whom it may concern:

Be it known that I, BRADLEY A. FISKE, lieutenant-commander United States Navy, residing at New York, in the county of New York and State of New York, have invented a certain new and useful Improvement in Methods of Controlling Moving Vessels or Vehicles, (Case No. 4,) of which the following is a full, clear, concise, and exact description.

My invention relates to an improvement in the art of controlling from a distance the mechanism of moving vessels or vehicles, my object being to obviate the necessity of physical connection by other than the natural medium in space between the moving object and the distant station from which it is to be controlled.

My invention is especially applicable to automobile torpedoes or other water craft, and the motor devices or mechanism controlled by my improved apparatus may be applied or adapted to the doing of any desired work in connection with the moving body. For instance, my invention is of especial value when use is made of it to control the steering mechanism of the vessel, and makes it possible to control the movements of a torpedo with great certainty from a shore, from the deck of a ship, or the like, without being hampered by certain practical difficulties which have heretofore stood in the way of successfully accomplishing such a result.

The principal reason why automobile torpedoes are not more extensively used in naval warfare is that with the apparatus heretofore available it has been extremely difficult while launching the torpedo to aim it with sufficient precision to strike the enemy's ship. It is usual at this time to launch or fire torpedoes from pneumatic tubes mounted upon carriages. These torpedo-tubes are placed in the ship either above or below the water-line. If they are below, the difficulty of accurate aiming is materially increased, while if they are above the water-line the loaded torpedo is exposed to the enemy's fire while the torpedo-tube and carriage are being manipulated. For this reason nearly all modern ships are constructed with their torpedo-tubes below the water-line.

It has heretofore been proposed to connect the torpedo with the ship by means of an electric cable, which is carried by the torpedo and unreeled as the latter continues on its course. This plan, however, has been found to be objectionable on account of the great length and weight of cable which is required for such a purpose, and numerous other practical difficulties have stood in the way of its successful operation.

In accordance with my invention at the point from which the mechanism upon the moving object is to be controlled means are provided for producing waves, impulses, or radiations—such, for instance, as the phenomena known as "Hertzian waves"—and which may be described for convenience as vibrations or disturbances of the universal ether, and upon the moving object motor mechanism for performing certain work upon the moving vessel—such, for instance, as the work of operating the steering-gear—is associated with a local circuit upon the vessel, which circuit controls the said motor mechanism and is adjusted or rendered sensitive to the waves, radiations, or etheric disturbances emanating from the distant station, whereby the said local controlling-circuit may be rendered active or inactive, and the operation of the said motor mechanism and the devices operated or controlled thereby may be effected from a distance without physical connection.

Amplifying the above statement somewhat and referring directly to the special object in view—that is, the control of an automobile torpedo—an electrical radiator may be located on shore or upon the ship from which the torpedo is launched, such radiator being capable of transmitting electrical waves of such peculiar and distinctive character or interrupted at such intervals of time as to constitute distinctive signals. The rudder of the torpedo may be connected with electromagnetic-motor mechanism for changing its position, whereby the torpedo may be steered, and this electromagnetic motor or steering mechanism may be associated with a local circuit or circuits and a source of current, such circuit being sensitive to or including a

device which is sensitive to the wave-signals sent out by the transmitting-station, means being provided whereby said circuit may select or respond to distinctive signals and thus control different movements of the steering apparatus. It is desirable that the apparatus on the torpedo should be capable of receiving and selecting a number of different signals which may be set up at the transmitting-station, so that different movements of the steering mechanism may be produced. For this purpose the responsive device may consist of a circuit including a source of current, such circuit being sensitive to or including a device such as a coherer, which is sensitive to electrical waves, and a number of signal-receiving instruments may be associated with the circuit which includes the coherer, each of said signal-receiving instruments being adapted to respond only when a distinctive signal peculiar to itself is impressed upon the receiving-circuit which includes the receiving-instruments and the coherer. To illustrate, suppose that the circuit upon the torpedo includes two signal-receiving instruments, each of which is adapted to respond to a pulsating or intermittent current of electricity of a given periodicity—that is, suppose that one of the instruments will respond to an electric current which is varied or interrupted at a given rate—say t times per second—and let the other signal-receiving instrument be adapted to respond to a current which is varied or interrupted at a different rate, say t' times per second. Let each of these signal-receiving instruments be so associated that when one of them is thrown into action the steering mechanism will be influenced in a particular way and when the other is thrown into action the steering mechanism will be influenced in another and different way. Now, it is evident that if the radiator at the transmitting-station be caused to send out electrical waves intermittently at the rate of t times per second, the coherer, when properly adjusted, by absorbing these intermittent waves or vibrations will intermittently at the rate of t times per second decrease the resistance of the local circuit which includes the signal-receiving devices, thereby producing in such local circuit a pulsating current with a corresponding frequency. One of the two signal-receiving instruments therefore will respond and influence the electromagnetic steering mechanism in the predetermined way, but the other receiving instrument will remain inactive. Likewise it will be evident that the latter instrument may be actuated by causing the radiator at the transmitting-station to send out electrical waves intermittently at the rate of t' times per second. It will be seen that by providing two such receiving instruments adapted one to control electromagnetic mechanism for putting the helm of the torpedo to starboard and the other to control similar mechanism for putting the helm to port if signals or electrical impulses having a periodicity or pitch corresponding to that of the receiving instruments on board the torpedo are sent out from the transmitting station by means of the Hertzian waves the torpedo may be steered at will from the transmitting-station by sending out signals to actuate either one or the other of the receiving instruments. The movements of the torpedo through the water can usually be followed by the eye by watching the air-bubbles that rise to the surface of the water, or the torpedo may be provided with apparatus for generating calcium-phosphide gas, which rises to the surface of the water and burns. These means are well known. Without going into detail it may be stated that the torpedo may be kept at a uniform depth—say about ten feet under water—by mechanism which is controlled by a hydrostatic piston. This is old in the art and needs no further description.

I will describe the details of my invention more particularly by reference to the accompanying drawings, in which—

Figure 1 is a diagrammatic illustration of a torpedo embodying my invention, this view being intended only to show the relative positions which are occupied by the explosive, the air-tanks, the engine or other propelling means, and the electrical steering apparatus which forms the subject of this application. Fig. 2 is a diagram showing the transmitting-station for sending out Hertzian waves of the required character. Fig. 3 shows in diagram the responsive apparatus provided on the torpedo for receiving signals sent out by the transmitting-station, and thereby actuating the electrical steering mechanism.

The same letters of reference are used to designate similar parts wherever they are shown.

In the stern of the torpedo a are provided two solenoids b b', having a core b^2 common to both of them. This core carries a pin b^3, which engages a slot c', provided in the end of the helm c. The helm is associated with the rudder in the usual manner. It will therefore be seen that if the solenoid b is energized and draws in the core the helm will be put to port, and that if, on the other hand, the solenoid b' is energized and the core b^2 attracted thereby the helm will be put to starboard. Now it will be understood that if means are provided for energizing either the solenoid b or the solenoid b' at will the torpedo may be steered in the direction desired. To effect this the solenoid b is included in a local circuit with a battery or source of current d. Similarly the solenoid b' is included in a local circuit with a battery e. The solenoid b, however, is normally short-circuited at d' through the resistance d^2, and likewise the solenoid b' is normally short-circuited at e' through the resistance e^2. The means for short-circuiting the solenoid b consist of a reed or spring d^3, normally resting upon the contact d^4, while

the means for short-circuiting the solenoid b' similarly consist in a reed or spring e^3, normally resting upon a contact e^4. Immediately under the reed d^3 is mounted the reed f^2 of the receiving instrument f, such reed f^2 being placed in inductive relation to the magnet f' of said receiving instrument. The reed f^2 has a characteristic pitch or rate of vibration and is adapted to be thrown into vibration only when electrical impulses of the same characteristic periodicity are impressed upon the circuit which includes its electromagnet f'. When, however, the reed f^2 is thus thrown into vibration, it strikes the end of the spring or reed d^3, whose rate of vibration is relatively much slower, and raises the spring d^3 from its contact d^4, thereby breaking the circuit of the battery d at that point. The current of the battery thereupon will flow only through the solenoid b, which will of course be energized. The circuit will remain broken at d' as long as the reed f^2 continues to vibrate.

A receiving instrument g, consisting of the magnet g' and reed g^2, is disposed in front of the reed e^3 and is similarly adapted to open the circuit of the battery e at the point e'. The reed g^2 has a characteristic pitch or rate of vibration which is different from the pitch of the reed f^2 and will be thrown into vibration only when electrical impulses of a periodicity corresponding to its characteristic pitch are impressed upon the circuit including the magnet g'. The receiving instruments f and g are included in series in a local circuit with the battery or source of current h, the continuity of this circuit being controlled by a coherer i, which is adapted to respond to Hertzian waves set up by a radiator k at the transmitting-station.

The form of coherer which is shown in the drawings is well known, but for the sake of clearness will be briefly described. A glass tube is fitted with two silver pole-pieces i' i', attached to rods i^2 i^2, which project out through the ends of the tube and are engaged by copper strips or brushes i^3 i^3, forming the terminals of the circuit which includes the battery h and the receiving instruments f and g. Choking-coils i^4 i^4 are provided in the circuit, one between the receiving instrument f and the brush i^3 and another between the receiving instrument g and the other brush i^3. The rods i^2 i^2 are mounted in bearings i^5 i^5 to permit the rotation of the glass tube.

Between the pole-pieces i' i' is provided a small quantity of powder, which may consist of a mixture of silver and nickel filings with a slight trace of mercury. Normally when the powder is in a disordered condition the resistance of the path through the coherer is extremely high—approximately twenty thousand ohms—but when its absorption of electric waves set up by the radiator is intense the particles of powder cohere, and the resistance of this path drops to something like five ohms, thereby practically closing the circuit. The powder remains cohered unless the tube is mechanically agitated, and to decohere the powder I preferably rotate the tube on its axis in the bearings i^5 i^5. This may be done by a belt passing from the pulley i^6 to the pulley i^7 of a small motor, which is kept constantly running.

The transmitting-station is illustrated in Fig. 2. The Hertzian radiator k consists, as usual, of three solid brass balls in alinement, the outer balls being connected to the terminals of the secondary winding of an induction-coil l. The primary winding of the induction-coil is included in circuit with a battery m, keys n and o, and vibrating make-and-break pieces n' and o'. The make-and-break piece n' consists of a reed n^2, whose characteristic pitch or rate of vibration is the same as that of the reed f^2 of the receiving instrument f, say t times per second. Similarly the reed o^2 of the make-and-break piece o' has a characteristic pitch or rate of vibration corresponding to that of the reed g^2 of the receiving instrument g, say t' times per second. The reeds n^2 and o^2 are kept in constant vibration by means of magnets n^3 o^3, which are included in circuit with a local battery p, and being in constant vibration alternately make and break contact with their respective contact-anvils n^4 o^4, which are connected with one terminal of the battery m. A condenser q is connected in multiple with the contacts of the vibrating make-and-break pieces and the keys n and o to suppress the sparks which would otherwise manifest themselves. When the key n is depressed, therefore, it will be understood that the radiator k will be caused to send out Hertzian waves whose frequency may be millions per second; but the operation of the radiator is intermittently interrupted by the make-and-break piece n', t times per second, which we have assumed to be the characteristic pitch or rate of vibration of the reed f^2, associated with the receiving instrument f upon the torpedo. The powder of the coherer i then will be influenced by the Hertzian waves, which are intermittently set up, as described, and will alternately cohere and decohere as many times in a second as the production of Hertzian waves from the radiator k is interrupted. This action, of course, results in intermittently reducing the coherer, battery h, and the two receiving instruments f and g.

Since we have assumed the rate of interruption at the radiator to be t times per second, it is manifest that a pulsating current whose frequency is t will be produced in such local circuit. Therefore the reed f^2, whose characteristic pitch or rate of vibration we have assumed to be t, is thrown into vibration; but the reed e^2, which vibrates at t' times per second, will remain quiet. The reed f^2, being thrown into vibration, will act in the manner heretofore described and open at the point d', the short circuit which includes the battery d thus causing the current from said battery to be directed through the solenoid

b, energizing the latter and putting the helm to port. In like manner if the key *o* is depressed intermittent impulses having a periodicity corresponding to the rate of vibration of the reed g^2 will be sent through the primary of the induction-coil by means of the vibrating make-and-break piece *o'*, and these intermittent impulses will affect the coherer on the torpedo-boat to cause intermittent impulses of the same periodicity to be supplied to the circuit which includes the receiving instruments *f* and *g*. Since these impulses have the same periodicity as the rate of vibration of the reed g^2, the latter will be thrown into vibration and current from the battery *e* thereby directed through the solenoid *b'* and the helm put to starboard. It will thus be seen that by depressing either the key *n* or the key *o* the torpedo may be steered in one direction or the other, as desired. An especial advantage of this arrangement is that the torpedo may be launched on the opposite side of the ship from the point which it is desired to attack and from which fire may be directed upon the ship, so that there is no danger of the torpedo being struck by an enemy's shot and exploded while being launched.

In Fig. 3 I have illustrated diagrammatically in dotted lines a supplemental coherer which may be included in multiple with the coherer *i*. This may be desirable in some cases to increase the sensitiveness of the signal-receiving apparatus acting as a guard against failure of the apparatus to operate if for any reason the coherer *i* should not work properly—that is to say, one of the coherers may respond a little more readily than the other to Hertzian waves of a given wave length or from a given distance, and the two may therefore be included in multiple with the circuit to be controlled, so that if one does not respond as quickly as it should the circuit may yet be controlled by the other. Such a supplemental coherer will not, however, in all cases be necessary or desirable, since ordinarily one coherer alone will be sufficient for the purpose.

This application is a division of my prior application, Serial No. 690,433, filed September 7, 1898.

Having thus described my invention, I claim as new and desire to secure by Letters Patent the following:

1. The herein-described improvement in the art of controlling the movements or operation of a vessel or vehicle, which consists in producing etheric waves or disturbances which are conveyed to the vessel by the natural media, and controlling by their influence exerted at a distance electromagnetic motor devices on the vessel or vehicle, which control the operating mechanism thereof, as set forth.

2. The herein-described improvement in the art of controlling the movements or operation of a vessel or vehicle, which consists in establishing a region of waves or disturbances and actuating by their influence exerted at a distance, electromagnetic motor devices on such vessel which control the operating mechanism thereof, as set forth.

3. The herein-described improvement in the art of controlling the movements or operation of a vessel or vehicle, which consists in establishing a region of electrical waves or disturbances and actuating by their influence exerted at a distance the devices on said vessel or vehicle which control the operating mechanism thereof, as set forth.

4. The herein-described improvement in the art of controlling the movements or operation of a vessel or vehicle, which consists in providing on the vessel a circuit controlling the operating mechanism of the vessel, adjusting or rendering such circuit sensitive to waves or disturbances of a definite character, establishing a region of such waves or disturbances, and rendering by their influence the controlling circuit active or inactive, as set forth.

5. The herein-described improvement in the art of controlling the movements or operation of a vessel or vehicle, which consists in providing in the vessel an electric circuit controlling electromagnetic motor devices for operating the mechanism of the vessel, adjusting or rendering such circuit sensitive to etheric waves or disturbances, establishing a region of such waves or disturbances, and rendering by their influence the controlling circuit active or inactive, substantially as set forth.

In witness whereof I hereunto subscribe my name this 12th day of March, A. D. 1900.

BRADLEY A. FISKE.

Witnesses:

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CHAS. CAMPBELL.