Oct. 5, 1926. 1,601,914

J. H. HAMMOND, JR

SYSTEM OF CONTROL BY LIGHT WAVES

Original Filed Dec. 27, 1916 2 Sheets-Sheet 1

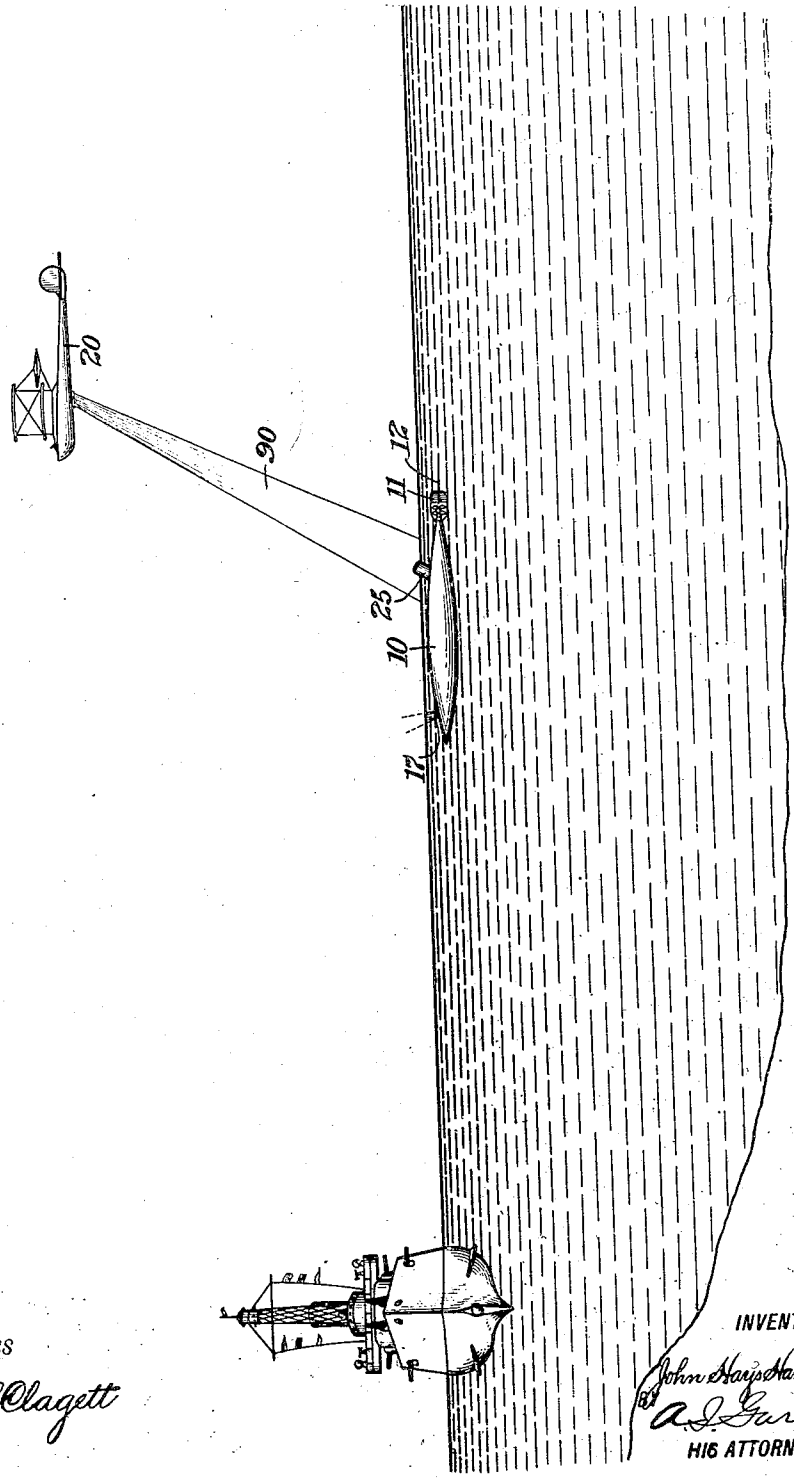


Fig. 1

WITNESS

Chas. J. Clagett

INVENTOR

John Hays Hammond Jr.

By A. L. Gardner.

HIS ATTORNEY

Oct. 5, 1926. 1,601,914

J. H. HAMMOND, JR

SYSTEM OF CONTROL BY LIGHT WAVES

Original Filed Dec. 27, 1916 2 Sheets-Sheet 2

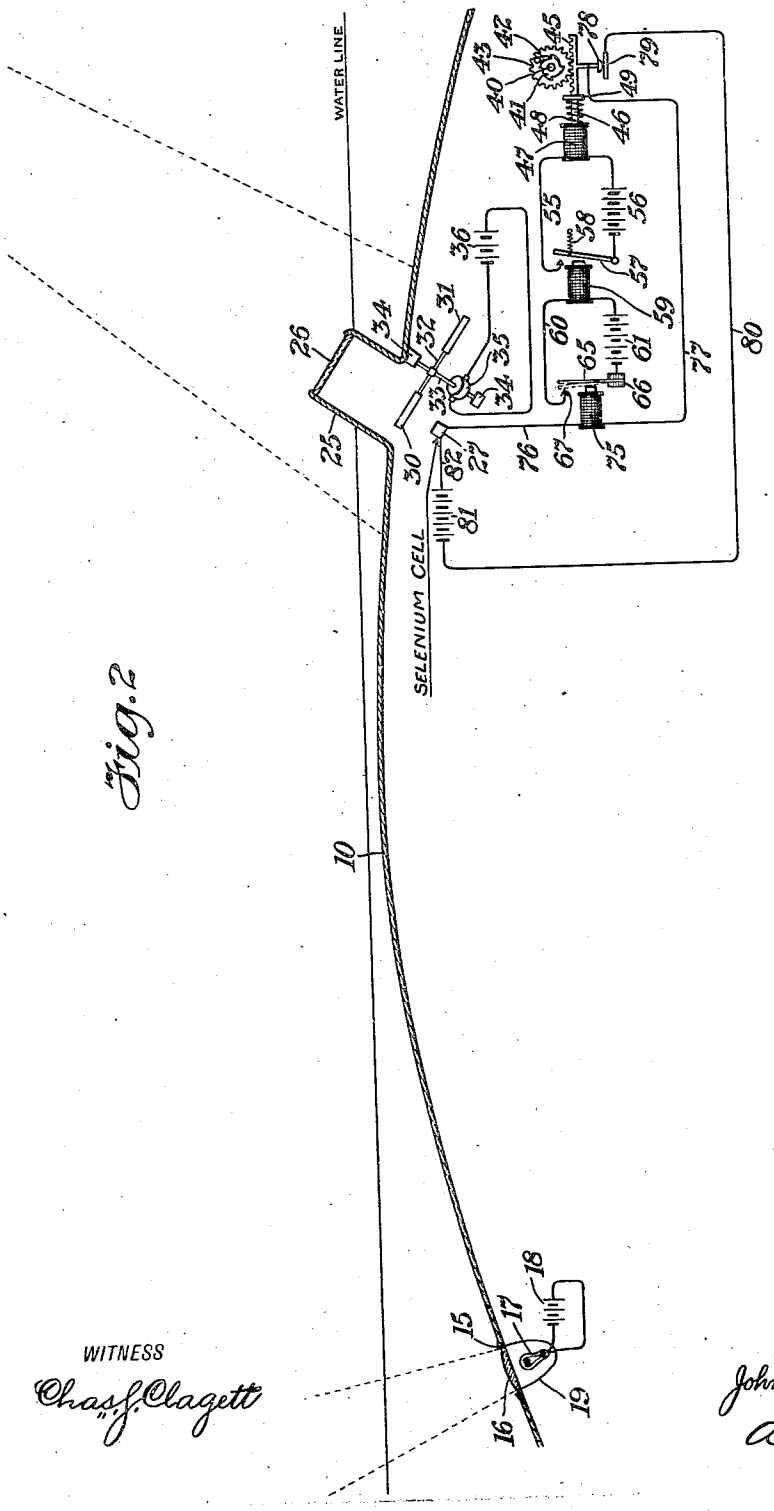


Fig. 2

WITNESS

Chas. J. Clagett

INVENTOR

John Hays Hammond Jr

BY

A. D. Gardner

HIS ATTORNEY

Patented Oct. 5, 1926. 1,601,914

UNITED STATES PATENT OFFICE.

JOHN HAYS HAMMOND, JR., OF GLOUCESTER, MASSACHUSETTS.

SYSTEM OF CONTROL BY LIGHT WAVES.

Application filed December 27, 1916, Serial No. 139,225. Renewed May 17, 1923.

Some of the objects of this invention are to provide an improved system whereby a submarine torpedo boat, or other movable submarine body, or other movable body, may be controlled by light waves; to provide a system of selective control by light waves; and to provide other improvements as will appear hereinafter.

In the accompanying drawings, Fig. 1 is a diagrammatic side elevation showing a submarine torpedo provided with a system constructed in accordance with this invention and controlled from an air craft; and Fig. 2 is an enlarged fragmentary, diagrammatic, longitudinal, central, vertical section of the torpedo boat shown in Fig. 1.

Referring to the drawings, one embodiment of this invention comprises a torpedo boat or other movable submarine body 10 provided with a normally substantially vertical rudder 11 arranged to oscillate with respect thereto about a substantially vertical axis, and also provided with one or more normally horizontal rudders 12 arranged to oscillate with respect thereto about a normally horizontal axis. The torpedo boat 10 is also provided upon its upper side near its bow with a circular opening 15 which is closed by a plano-convex or other suitable lens 16 beneath which is arranged an electric lamp 17 which is arranged to be energized by a battery 18, and which is surrounded by a reflector 19 fixed in the torpedo boat 10 and opening towards the lens 16 to throw a well defined beam of light upwardly through the water from the torpedo boat.

For steering the torpedo boat 10 in any desired direction in response to a light beam from a hydro-aeroplane 20 or from any other suitable air craft or station, the upper surface of the rear portion of the torpedo boat 10 is provided with an upwardly and rearwardly projecting tubular extension 25 which is substantially circular in transverse section and the outer end of which is closed by a flat circular transparent disc 26 of glass or other suitable material, which is preferably arranged in a plane perpendicular to the longitudinal axis of the tubular extension 25.

Arranged within the torpedo boat 10 and in axial alinement with the tubular extension 25 is a selenium cell 27 or other suitable element, the electrical conductivity of which is changed when exposed to light waves, and which is fixed in position with respect to the torpedo boat 10. Arranged to rotate in a plane parallel to the transparent closure 26 and between the closure 26 and the selenium cell 27 are two transparent containers 30, 31, which for a purpose hereinafter described are filled with sodium gas or other suitable fluid or material, which will permit the passage of the light of the sun and various other kinds of light therethrough without any appreciable diminution, but which will absorb and prevent the passage of a light formed by the burning of a metal sodium or some other predetermined material. These containers 30, 31 are rigidly secured to the opposite ends of a rigid bar 32 which is centrally secured fixedly to a rigid spindle 33 which is arranged parallel to the longitudinal axis of the tubular extension 25. The spindle 33 is held against longitudinal movement and is supported for rotation in any suitable bearings 34 fixed with respect to the torpedo boat 10, and the spindle 33, together with the containers 30 and 31 carried thereby, are arranged to be rotated at a predetermined rate by an electric motor 35 which receives energy from a battery 36 or other suitable source.

The rudders 11 and 12 are controlled either electrically or pneumatically by any well known or suitable system, which in the form of the invention shown is controlled by any suitable commutator or valve which is arranged to be actuated by a shaft 40 which is arranged to rotate about an axis fixed with respect to the torpedo boat 10. For rotating this shaft 40 step by step to control the rudders 11 and 12, a ratchet 41 is rigidly secured to the shaft 40 and is arranged to be rotated step by step through the action of a spring pressed pawl 42 which is pivotally connected to a gear 43 which loosely surrounds the shaft 40 and which is engaged by a rack 45 one end of which is rigidly secured to the core 46 of a solenoid 47 which is fixed with respect to the boat 10. The rack 45 is normally held in the position shown by means of the spiral spring 48 which surrounds the core 46 and is normally slightly compressed between the solenoid 47 and a collar 49 fixed upon the core 46. The solenoid 47 is in a normally open circuit 55 including a battery 56 and controlled by a switch 57 which is normally held open by a spring 58 and which forms the armature of

an electromagnet 59 which is in a normally open circuit 60 which includes a battery 61 and which is controlled by a resilient reed 65, one end of which is rigidly secured to a fixed support 66 and the other end of which is arranged to swing into and out of engagement with a fixed contact 67 to open and close the circuit 60.

The reed 65 is so selected and adjusted as to have a natural period of vibration having a frequency per second equal to twice the number of revolutions per second of the shaft 33 carrying the transparent containers 30 and 31. The reed 65 is normally out of engagement with the contact 67 but is arranged to be drawn into engagement periodically with the contact 67 when the system is in operation by means of an electromagnet 75. One end of the winding of the electromagnet 75 is connected by a conductor 76 to one side of the selenium cell 27, and the other end of the winding of the electromagnet 75 is connected by a conductor 77 to a contact 78 which is carried by but insulated from the rack 45. This contact 78 is arranged to engage slidably upon a contact 79 which is fixed with respect to the boat 10, and which is connected by a conductor 80 with one pole of a battery 81, the other pole of which is connected by a conductor 82 to the selenium cell 27 in such a manner that the selenium cell forms a resistance in the circuit from the battery. The contact 79 is of such a length and so arranged that normally the movable contact 78 bears upon the fixed contact 79, but when the solenoid 47 has been energized and the rack 45 has been moved towards the left into its extreme left hand position, then the movable contact 78 will be upon the left hand side of the fixed contact 79 and spaced therefrom, thus breaking the circuit through the selenium cell 27, electromagnet 75 and battery 81.

The hydroaeroplane 20 or other transmission station is provided with any well known or suitable means for transmitting a well defined beam 90 of sodium or other suitable light, produced by burning the metallic element sodium or other suitable element in a suitable flame, and reflecting the light produced thereby to form the beam 90, a suitable adjustable reflector being used to direct the beam 90 in any desired direction.

In the operation of this system, when it is desired to rotate the shaft 40 upon the torpedo boat 10 through one or more steps to control the rudders 11 and 12, the beam 90 of sodium light is thrown upon the transparent closure 26 of the torpedo boat, and as the transparent containers 30 and 31 are constantly rotating at a predetermined rate, these containers interrupt or nullify the action of the beam of sodium light 90 upon the selenium cell 27 at a frequency equal to twice the frequency of the rotation of the shaft 33. This interruption of the action of the beam 90 of sodium light by the transparent containers 30 and 31 containing sodium gas is in accordance with a well known principle, and it is to be understood that instead of using a sodium light and having the containers 30 and 31 filled with sodium gas, the light from any other metal such, for instance, as potassium or any other suitable metal of the alkali group or any other suitable metal or material, or any other suitable light, may be used to form the beam 90, and the transparent containers 30 and 31 would then be filled with a corresponding gas of suitable material to interrupt or nullify the action of the beam 90 upon the selenium cell 27. The interruption of the beam 90 by the containers 30 and 31 varies the resistance of the selenium cell 27 in a well known manner and at a rate equal to the rate of interruption of the beam 90 by the transparent containers 30 and 31, thus producing oscillations in the current from the battery 81 through the cell 27 and the electromagnet 75. The frequency of these oscillations is the same as the natural frequency of the frequency of oscillation of the tuned reed 65, and therefore the tuned reed is set into vibration and the free end of the reed is thrown repeatedly into and out of engagement with the fixed contact 67, thus closing and opening the circuit through the battery 61 and electromagnet 59 repeatedly in quick succession, and thus energizing the electromagnet 59 sufficiently to close the circuit through the battery 56 and solenoid 47, thereby drawing in the core 46 and rotating the gear 43 and consequently the shaft 40 through one step.

In thus moving the rack 45 into its extreme left hand position, the contact 78 is moved out of engagement with the fixed contact 79 for a brief but appreciable period, thus breaking the circuit through the selenium cell 27 for a corresponding period, and thus de-energizing for the same period the electromagnet 75 and consequently the electromagnet 59 and the solenoid 47, and thus permitting the rack 45 to return towards the right a short distance until the movable contact 78 is again brought into engagement with the fixed contact 79, whereupon if the beam of light 90 is still directed upon the transparent closure 26 the rack 45 and the movable contact 78 carried thereby will immediately be moved again slightly towards the left until the movable contact 78 moves out of engagement with the contact 79 for a brief but appreciable period, and there will be a substantially continuous reciprocation of the movable contact 78 through a short path into and out of engagement with the left hand end of the fixed contact 79 without changing the position of the shaft 40, and so long as the beam 90 of sodium light is continuously directed upon the trans-

parent closure 26. This breaking of the circuit through the selenium cell 27 prevents the selenium cell from becoming overheated and inoperative due to the action of the current through the cell from the battery 81.

After the shaft 40 has thus been rotated through one step, the beam of light 90 is directed away from the transparent closure 26, thus causing a cessation in the oscillations through the electromagnet 75 and therefore the tuned reed 65 resumes its normal position and causes the de-energization of the electromagnet 59 and the solenoid 47, and permits the rack 45 to be moved into its extreme right hand position under the action of the spring 48 without affecting the position of the shaft 40.

If, now, it should be desired to rotate the shaft 40 through another step, the beam of light 90 is again directed upon the transparent closure 26 and the hereinbefore described process is repeated, and the shaft 40 is thus rotated step by step through any desired number of steps to control the rudders 11 and 12 and consequently the direction of movement both in a horizontal plane and in a vertical plane of the torpedo boat 10.

It is thought to be evident from the foregoing that this invention provides a system for controlling the direction of movement of a torpedo or other movable body in response to light waves only of a given character and which will not be affected by sunlight, electric light, calcium light, or any other ordinary forms of light. It is also evident that this invention might be applied not only in steering a vessel, but for various other purposes.

Although only a single form has been shown herein in which this invention may be embodied, it is to be understood that the invention is not limited to any specific form but might be applied in various forms and for various purposes without departing from the spirit of this invention or the scope of the appended claims.

Having fully described this invention, I claim:—

1. The combination with means for generating light by the burning of a given material, of means for receiving said light comprising an electric circuit including a source of electric energy and an element having a normal resistance which may be varied by the action of said light, and modifying means operating between said first mentioned means and said element to intercept said light periodically and at a given frequency, said modifying means including a transparent container containing a transparent substance having the property of absorbing said light, and a device tuned to said frequency and arranged to be actuated as a result of the action of said circuit.

2. The combination with means for generating light by the burning of a given metal, of means for receiving said light comprising an electric circuit including a source of electric energy and an element having a normal resistance which may be varied by the action of said light, and modifying means operating between said first mentioned means and said element to intercept said light periodically and at a given frequency, said modifying means including a transparent container containing a transparent substance having the property of absorbing said light, and a device tuned to said frequency and arranged to be actuated as a result of the action of said circuit.

3. The combination with means for transmitting a beam of sodium light, of receiving means comprising an electric circuit containing a source of electric energy and an element the apparent conductivity of which may be varied by the action of said sodium beam, modifying means operating between said first mentioned means and said element, and including a transparent container containing sodium gas and movable so as to vary the action of said beam upon said element periodically and at a given frequency, and a device tuned to said frequency and arranged to be actuated as a result of the action of said circuit.

4. A system for controlling the direction of movement of a dirigible body comprising an electric circuit including a source of electric energy and an element the resistance of which may be varied by the action of light waves, a beam of light arranged to continuously act upon said element, means to periodically modify the character of said beam of light to cause periodic variations in said circuit, and a device tuned to the frequency of said variations and arranged to be actuated as a result of the action of said circuit.

5. The combination with means for generating light having only the part of the spectrum at the sodium line, of means for receiving said light comprising a mass of sodium gas to absorb the received signal light, an indicating device to produce a signal, and means for rendering the gas periodically ineffective with respect to the indicating device.

6. The combination with means for generating light having only a predetermined portion of the spectrum contained therein, of means for receiving said light comprising a mass of material capable of absorbing said portion of the spectrum but transparent to other portions thereof, a signal device controlled by light passing through said mass, and means for intermittently moving the mass to intercept the signal light periodically.

7. The combination with means for gen-

erating light having a limited spectrum band, of means for receiving said light comprising a tuned signal device responsive to light waves interrupted at a predetermined rate, light intercepting means including material which absorbs said spectral band, and a motor for operating the intercepting means to cause it to intercept the light at said predetermined rate.

8. The combination with means for generating light having a specific spectrum, of means for receiving said light comprising a mass of material adapted to absorb the said specific spectrum, an indicating device to produce a signal, and means for rendering said mass of material periodically ineffective with respect to the indicating device.

Signed at Gloucester in the county of Essex and State of Mass. this nineteenth day of December A. D. 1916.

JOHN HAYS HAMMOND, JR.