No. 714,862. Patented Dec. 2, 1902.

H. W. BUCK.

CONTROLLING ELECTRIC MOTORS.

(Application filed Nov. 17, 1900.)

(No Model.) 2 Sheets—Sheet 1.

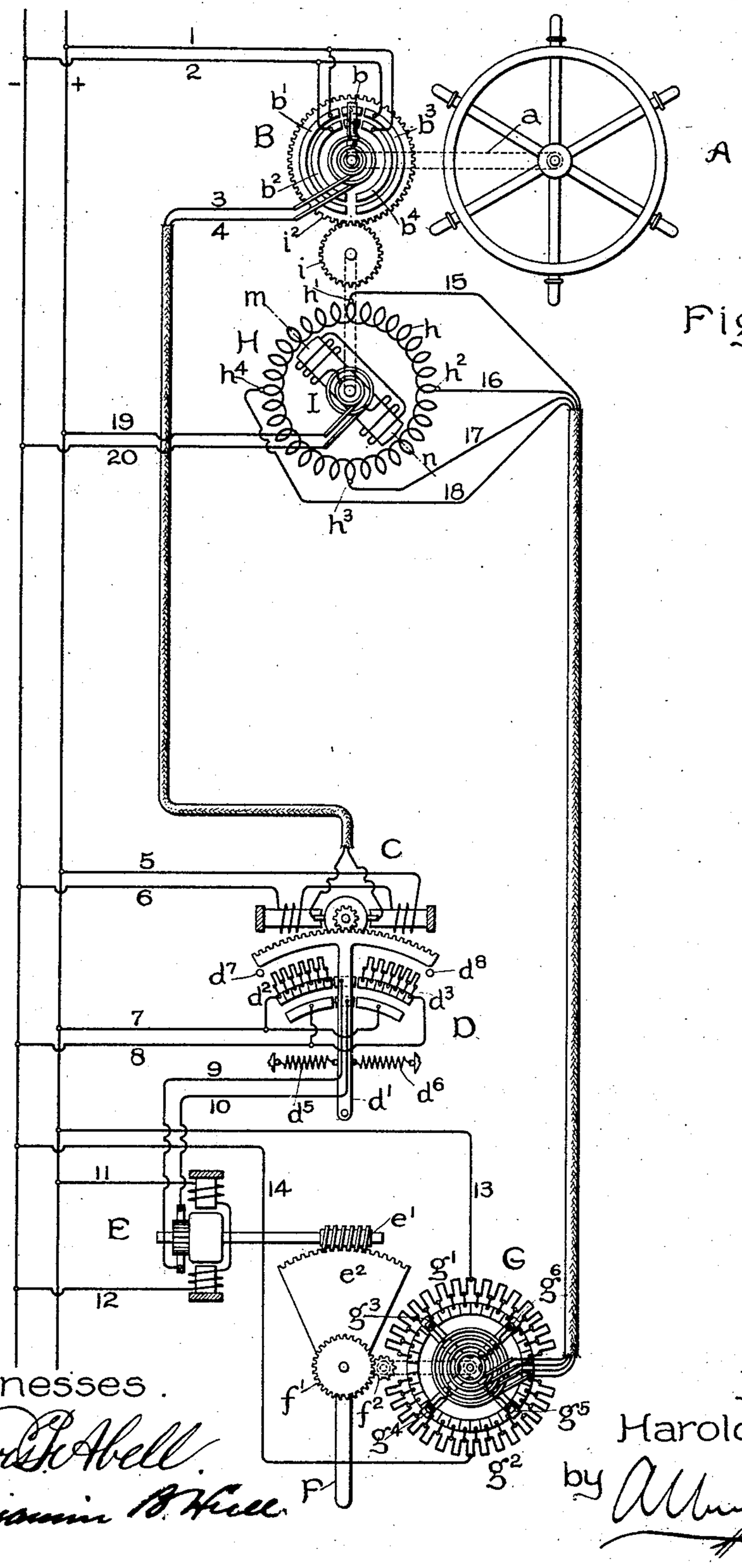

Fig. 1.

Witnesses.
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Benjamin B. Hull.

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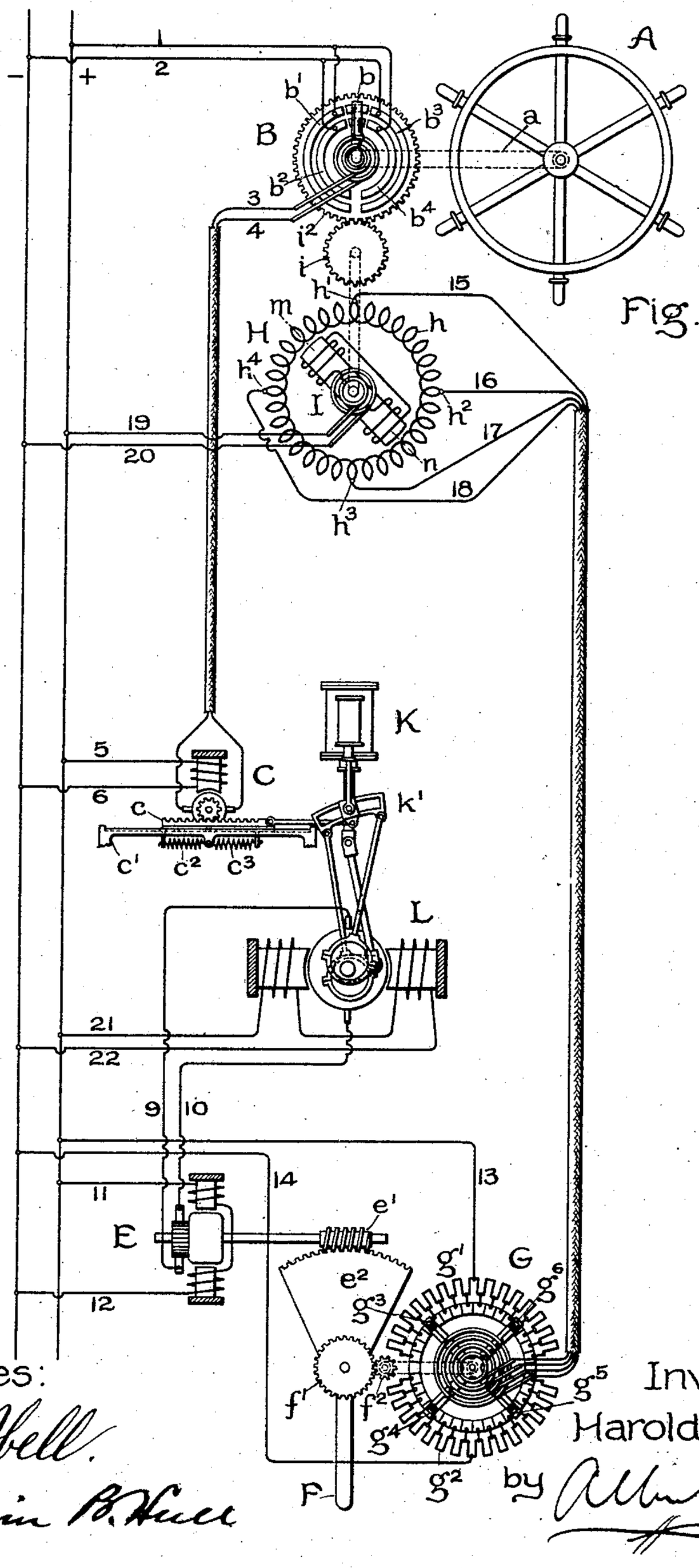

Fig. 2.

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UNITED STATES PATENT OFFICE.

HAROLD W. BUCK, OF NIAGARA FALLS, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

CONTROLLING ELECTRIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 714,862, dated December 2, 1902.

Application filed November 17, 1900. Serial No. 36,810. (No model.)

To all whom it may concern:

Be it known that I, HAROLD W. BUCK, a citizen of the United States, residing at Niagara Falls, county of Niagara, State of New York, have invented certain new and useful Improvements in Controlling Electric Motors, (Case No. 1,214,) of which the following is a specification.

My present invention relates to means for producing a predetermined movement at a distant point, and comprises an improved system especially adapted for use in ship-steering as a means for controlling from the pilot-house the movement of the rudder, although it is not limited to such application.

My invention will be understood by reference to the following description, taken in connection with the accompanying drawings, while its scope will be pointed out in the appended claims.

In the drawings, Figure 1 is a diagrammatic representation of my controlling system as applied to ship-steering, and Fig. 2 shows a modification of the system of Fig. 1.

Referring to Fig. 1, A indicates a steering-wheel, which may be located at any desired point on the ship and which is connected by any suitable gearing (indicated in the drawings by the dotted-line connection *a*) to one of the members of a controlling device or switch B. As shown, the steering-wheel is connected to the member *b* of the switch B, this member being provided with two contacts which are connected, through collecting-rings and brushes, to the conductors 3 and 4. The other member of the switch B is provided with two sets of circularly-arranged contacts b' b^2 and b^3 b^4, which are reversely connected with the mains + and − (which may be the lighting-mains of the ship) by means of the conductors 1 and 2. The conductors 3 and 4 are led through a cable to the armature of a pilot-motor C, of which the field-winding is connected by means of conductors 5 and 6 to a suitable source of direct-current supply—as, for example, the mains + and −. In some of the claims this motor is referred to as a "second" motor. The motor C is operatively connected by means of any suitable gearing—a pinion and segmental rack, as shown in the drawings—to one of the members of a combined starting and reversing switch D, which is in the circuit of the main motor E. The main motor E is therefore started and stopped by means of the manually-controlled switch B, operating through the second or pilot motor C, and the motor starting and reversing switch which is operatively connected thereto. In the construction shown the armature-shaft of the motor C is geared to the arm d' of the rheostatic switch, this arm being provided with two contacts which are suitably connected to the conductors 9 and 10. The resistance-contacts d^2 and d^3 of the switch D are reversely connected to the mains + and − by means of the conductors 7 and 8, so that when current is supplied to the motor C in one direction or the other the switch-arm d' will be moved to supply current in one direction or the other from the mains + and − through the conductors 7 8 and 9 10 to the armature of a main motor E, the field-windings of which are connected, by means of conductors 11 and 12, to the + and − mains. If desired, two separate switches may be used in place of the combined starting and reversing switch, or in case movement in one direction only is desired only the starting-switch need be used. The motor E is located adjacent to the rudder and is connected to the rudder F through any suitable gearing—as shown through the worm e' and pinion e^2. Adjacent to the rudder is located a transmitting device G, comprising a plurality of rheostats g' and g^2, the contacts of which are arranged in a circle. Each of the two rheostats is connected at its middle point to one of the mains + and − through the conductors 13 and 14. A plurality of brushes g^3 to g^6, inclusive, are suitably supported for rotation over the contacts of the rheostats, and each of these brushes is connected, through a collecting-ring and brush, to one of the conductors 15 to 18, inclusive, which lead through a cable to the winding of an electromotive device H, located adjacent to the switch B. The transmitting device is connected to the rudder and to the motor E by means of any suitable gearing, such a gearing being indicated in the drawings by the gears f' and f^2, the former of which is connected to the rudder-post and the latter to the rotating member of

the transmitting device. The electromotive device H comprises two members, one of which is polarized in a definite direction by means of current supplied from the mains + and — through the conductors 19 and 20, and the other of which is provided with a winding so connected to the conductors 15 to 18, inclusive, that the said member will be polarized in successively-advancing positions as the rotatable member of the transmitting device G is advanced by the movement of the rudder. The electromotive device therefore operates in synchronism with the rudder and its operating-motor—that is, there is at all times a definite fixed relation between the movements of the rudder-operating motor and the synchronous electromotive device. It therefore follows that any given angular movement of the rudder or of the motor which drives it will be accompanied by a certain definite angular movement of the synchronous electromotive device and of that member of the switch B to which it is operatively connected. The electromotive device will operate in synchronism with the rudder-operating motor to shut off the supply of current to the said motor when it has been rotated by an amount corresponding to the relative movement originally given to the members of the switch B. As shown, the transmitting device G is provided with but four brushes, the diametrically opposite brushes being connected to diametrically opposite points in the winding h of the motive device H. It is of course evident that any desired number of brushes and connecting-conductors may be used. In the particular position of the transmitting device indicated in the drawings current flowing from the + main through the conductor 13 to the middle point of the rheostat g' will divide equally, a part flowing through the brush g^3 and the conductor 15 to the point h' in the winding h, another part flowing through the brush g^6 and the conductor 18 to the point h^4 in the winding h, the return-circuit leading through the portion of the winding h between the points h' and h^2 and h^4 and h^3 and back by way of conductors 16 and 17 and brushes g^4 and g^5 to the rheostat g^2 and thence to the conductor 14, connected to the main. The fixed member of the motive device H will therefore be polarized by current flowing from the mains + and — through the transmitting device G and the winding h of the motive device along the line m n, and the rotatable member I of the said motive device will be positively held in the position shown in the drawings. As the brushes of the transmitting device are rotated the line of polarization will be gradually shifted, and when the brushes g^3 and g^5 of the transmitting device lie directly under the middle points of the rheostats g' and g^2 current will be supplied through the conductors 15 and 17 only, and the fixed member of the motive device H will be polarized along the line joining the points h' and h^3. Further rotation of the transmitting device will cause the line of polarization of the fixed member of the motive device H to gradually shift until when the brushes g^4 and g^6 lie opposite the middle points of the rheostats g' and g^2, respectively, current will be supplied to the winding of the said motive device through the conductors 16 and 18 only, and the fixed member of the said motive device will be polarized along the line joining the points h^2 and h^4, and so on as the rotatable member of the transmitting device is rotated. The rotatable member of the motive device H is connected by means of any suitable gearing—as shown through the gears i and i^2—to that member of the switch B on which the contacts b' to b^4, inclusive, are mounted, so that as the brushes of the transmitting device are moved by the rudder this member of the switch B will be correspondingly or synchronously moved by the motive device H.

The operation of the system above described is as follows: Supposing the steering-wheel A to be rotated to the left, for example, by any predetermined amount, the member b of the switch B will be correspondingly rotated, and its contacts will be caused to move over the contacts b' and b^2 by an amount dependent upon the movement given to the steering-wheel. Current will then be supplied from the mains + and — through the conductors 1 2, the contacts b' b^2, and the contacts on the member b of the switch B to the conductors 3 4, which lead to the armature of motor C, and the said motor will be caused to rotate in one direction—say right-handedly—so as to close the circuit of the motor E through the conductors 7 8 9 10 and the resistance d^2. The motor C will continue to run until the switch-arm d' is brought into engagement with the stop d^7 at the left, when the starting resistance d^2 will be entirely cut out of circuit. As soon as the contacts carried by the member d' of the switch D are brought into engagement with the resistance-contacts d^2 the motor E will start, and when the switch D has been brought to its full-on position it will run at full speed and will move the rudder F through the gearing already described. The rudder in moving will cause the brushes of the transmitting device to rotate over the contacts of the two rheostats g' and g^2 and the polarization of the fixed member of the motive device H will be gradually shifted, thereby causing the member I of said motive device to move by an amount corresponding to the movement of the rudder and to rotate the member of the switch B, on which the contacts b' and b^2 are mounted, to the left until finally the circuit is broken between the contacts b' and b^2 and the contacts carried by the member b. When this point is reached in the movement of the switch B, the circuit of the motor C will be opened and the springs d^5 and d^6 will return the member d' of the switch D to its off position, thereby opening the circuit to the motor E, which will

then come to rest. The ratio of the gearing between the motor E, the rudder F, and the transmitting device G to the gearing between the motive device H and the switch B is so chosen that when the rudder has been moved by an amount corresponding to the movement given to the steering-wheel A the members of the switch B will be brought to the relative position shown in the drawings.

The system shown in Fig. 2 is similar in its general features to the system above described; but in place of the rheostat D by which current is supplied to the motor E in Fig. 1, I have substituted the valve-gear of a reversible engine which is arranged to operate a dynamo connected to supply current to the motor E. In the system shown in Fig. 2 whenever the motor C is actuated in the one direction or the other the rack *c* is caused to move against the tension of one of the springs c^2 and c^3 along the guides *c'*. This rack is connected to a Stevenson link-motion, and as it is thrown to one or the other of its extreme positions the valves of the engine K are moved, so as to cause the engine to rotate the armature of the dynamo L in one direction or the other, and therefore to supply current in one direction or the other to the motor E.

In both of the systems illustrated in the drawings the switch B and the motive device are preferably arranged beneath the deck adjacent to the pilot-house or bridge and the motor E and the transmitting device G adjacent to the rudder. The starting-switch D (shown in Fig. 1) may evidently be located at any desired point between the pilot-house and the rudder, preferably either at the rudder itself or in the dynamo-room, where it may be under the inspection of an engineer. With the arrangement shown in Fig. 2 the engine K and its dynamo L may evidently also be located at any desired point in the ship; but they are preferably located in the dynamo or engine room.

I have not attempted to illustrate any details of construction of the apparatus which goes to make up the system which constitutes my present invention, for the reason that such details are well understood in the art to which my invention relates.

Many changes in the specific apparatus employed may be made and other different means which are capable of accomplishing substantially the same results may be substituted for the elements or groups of elements illustrated without departing from the spirit and scope of my invention. In order to render this clear, I have used in the claims hereto appended broad general terms for defining the separate elements or groups of elements which are essential to the several combinations claimed.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. The combination of a motor, manually-controlled means for starting the motor, and a synchronous electromotive device which when in operation tends to stop the motor.

2. The combination of a motor, manually-controlled means for supplying current to the motor, and an electromotive device which operates in synchronism with said motor and acts to shut off the supply of current to said motor.

3. The combination of a motor, a starting and stopping device therefor, means for operating said device to start the motor, and a synchronous motive device adapted to act on said starting and stopping device to stop the motor.

4. The combination of a motor, manually-controlled means for starting the motor, and a synchronous electromotive device operated in synchronism with the motor and arranged to stop said motor at a predetermined point in its movement.

5. In combination, an electric motor, a starting-switch for said motor, manually-controlled means for closing said switch, and a synchronous electromotive device operated in synchronism with the motor and arranged to cause the opening of the starting-switch.

6. In combination, a body to be moved, an electric motor connected thereto, a switch for said motor, means for closing said switch, and an electromotive device which operates in synchronism with said motor for opening said switch.

7. In combination, a body to be moved, an electric motor operatively connected thereto, a pilot-motor for controlling the supply of current to said electric motor, a controlling device for said pilot-motor, means for moving said controlling device by an amount corresponding to the desired movement of the body to be moved, an electrical means operated by the body to be moved for returning said controlling device to its off position.

8. In combination, a body to be moved, an electric motor connected thereto, a starting-switch for said motor, manually-controlled means for operating said switch, and a synchronous electromotive device operated in synchronism with the body to be moved and arranged to cause the opening of said switch at a predetermined point in the movement of said body.

9. In combination, a main electric motor, means for controlling the operation of said motor, a second motor operatively connected to said controlling means, a switch for said second motor, manually-operated means for closing said switch, and an electromotive device operated upon the movement of the main motor for opening the same.

10. In combination, a main motor, a pilot-motor for controlling the operation of said main motor, a circuit-closer for the pilot-motor, and electrical means for transmitting motion from the main motor to the circuit-closer.

11. In combination, a main motor, a pilot-motor for controlling the operation of said

main motor, a circuit-closer for the pilot-motor, and a synchronous electromotive device operated in synchronism with the main motor and connected to the circuit-closer.

12. In combination, a main motor, a starting-switch for said motor, a pilot-motor for operating the starting-switch, a manually-operated circuit-closer for the pilot-motor, and electrical means operatively connected to the main motor for opening said circuit-closer.

13. In combination, a body to be moved, a main motor operatively connected to said body, a pilot-motor for controlling the operation of the main motor, a circuit-closer for the pilot-motor, and a synchronous electromotive device operated in synchronism with the body to be moved, and connected to said circuit-closer.

14. In a steering-gear, the combination of a rudder to be actuated, a motor for actuating the rudder, a starting and stopping device for the motor located at a distance from the motor, and an electrical device for transmitting synchronous motion between said motor and said starting and stopping device.

15. In a steering-gear, an electric motor operatively connected to the rudder, a combined starting and reversing switch for said motor, means for maintaining said switch normally in its off position, a pilot-motor for actuating said switch, a switch for said pilot-motor operatively connected to the steering-wheel, and a synchronous electromotive device connected to said switch and operated in accordance with the movement of the rudder.

16. In a steering-gear, an electric motor operatively connected to the rudder, a starting-switch for said motor, means for maintaining said switch normally in its off position, a pilot-motor for actuating said switch, a switch for said pilot-motor comprising two relatively movable members, one of which is operatively connected to the steering-wheel and the other of which is operatively connected to the rudder.

17. In a steering-gear, a main motor operatively connected to the rudder, a pilot-motor for controlling the operation of the main motor and a switch in circuit with said pilot-motor comprising two relatively movable members, one of which is operatively connected to the steering-wheel and the other of which is operatively connected to the rudder.

18. In a steering-gear, an electric motor operatively connected to the rudder, a starting-switch for said motor, a pilot-motor for actuating said switch, a switch for said pilot-motor comprising two relatively movable members, and a connection between said switch and the steering-wheel whereby its two members may be caused to occupy any desired relative position, and a connection between said switch and the rudder whereby the switch members will be caused to move to their off position as the rudder is moved by the motor connected thereto.

19. In a steering-gear, a main motor operatively connected to the rudder, a pilot-motor for controlling the operation of the main motor, a switch comprising two relatively movable members in circuit with said pilot-motor, a connection between said switch and the steering-wheel whereby its two members may be caused to occupy any desired relative position, and a connection between said switch and the rudder whereby the two members of the switch will be moved to their off position when the rudder occupies a position corresponding to the position to which the pilot-motor switch has been moved by the steering-gear.

20. The combination of a body to be moved, a motive device operatively connected thereto, an electrically-operated pilot-motor for controlling the operation of said motive device, a switch in circuit with the pilot-motor, manually-controlled means for closing said switch, and a synchronous electromotive device connected to operate in synchronism with the body to be moved and arranged to open the pilot-motor circuit when the said body has been moved by an amount corresponding to the movement of the manually-controlled switch-closing means.

21. The combination with a motor, of a controlling device for starting and stopping said motor located at a point distant therefrom, means for operating said device to start the motor, and electrical means arranged to move synchronously with said motor for operating said device to stop the motor.

In witness whereof I have hereunto set my hand this 15th day of November, 1900.

HAROLD W. BUCK.

Witnesses:
BENJAMIN B. HULL,
MARGARET E. WOOLLEY.