(No Model.)

B. A. FISKE.

MEANS FOR REGULATING AND CONTROLLING ELECTRIC MOTORS.

No. 381,228. Patented Apr. 17, 1888.

Fig 1.

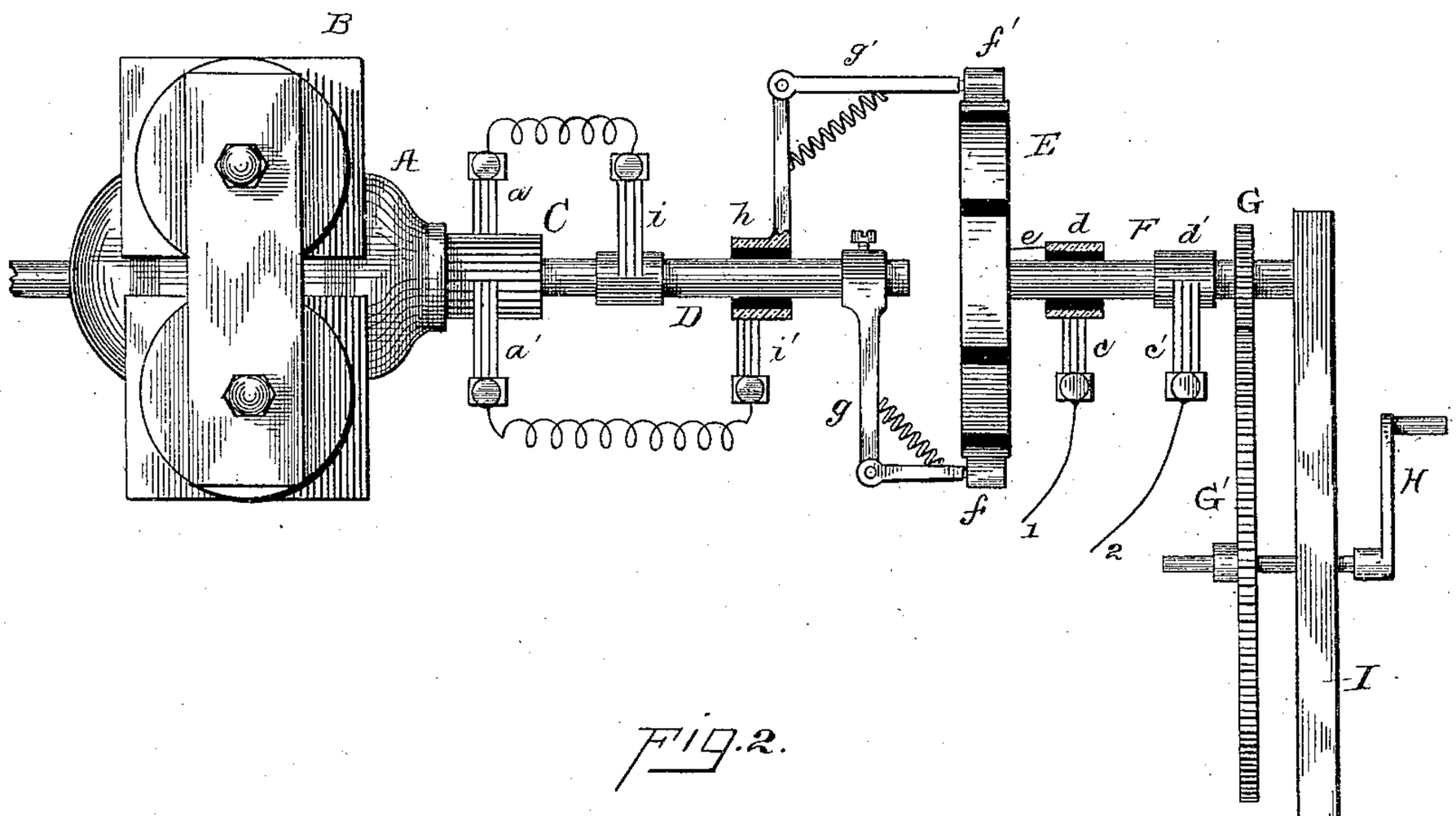
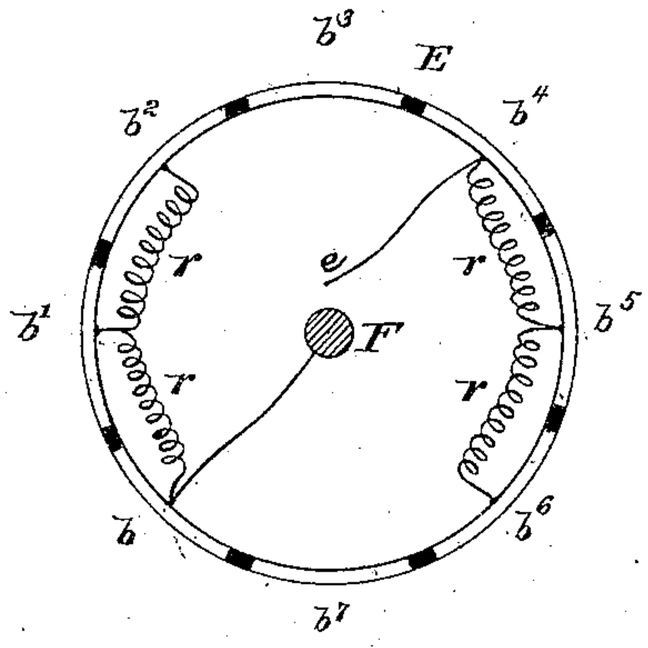


Fig. 2.



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BRADLEY A. FISKE, OF THE UNITED STATES NAVY.

MEANS FOR REGULATING AND CONTROLLING ELECTRIC MOTORS.

SPECIFICATION forming part of Letters Patent No. 381,228, dated April 17, 1888.

Application filed June 27, 1887. Serial No. 242,581. (No model.)

To all whom it may concern:

Be it known that I, BRADLEY A. FISKE, of the United States Navy, have invented a certain new and useful Improvement in Methods of and Means for Regulating or Controlling Electric Motors, of which the following is a specification.

The object of my invention is to enable the speed or direction, or both, of the rotation of an electro-dynamic motor to be regulated or varied in a simple and effective manner. To accomplish this I employ, generally speaking, a device or mechanism designed to be continuously operated by the hand of an operator and connected with the motor through current-varying devices or other regulating apparatus in such manner that the movements of the motor will conform or correspond in speed or direction, or both, to the movements given by the hand to such hand mechanism—that is, when the operator works faster or slower the motor will run faster or slower, when the operator stops the motor will stop, and when the operator reverses his movement the direction of rotation of the motor will be reversed. The method of operation, therefore, which forms a feature of my invention, consists, mainly, in regulating the speed or direction of rotation, or both, of the motor correspondingly to variations in the speed or direction, or both, of hand-operated mechanism.

Heretofore in the operation of electro-dynamic motors in situations where the necessity for continual regulation arises—for instance, in the running of street-cars or in the training of heavy guns on shipboard or elsewhere—the regulating devices used or proposed have been switches or commutators with movable arms, which would be moved to one part or another of the commutator to so affect the circuits as to produce the desired effect on the motor. The advantage of my method over this is that in it no reasoning or effort of mind is required on the part of the operator; but he has simply to obey his unconscious instinct, which leads him to do that to which he has been always accustomed in the daily operations of life—that is, he has to make similar motions to those he wishes to give to the motor—while in the old forms the motions of the operator are dissimilar to those which they produce in the motor. In the preferred arrangement of my apparatus, for instance, the operator merely continues to turn a crank, and if he wishes the motor to run faster or slower he turns the crank faster or slower. If he wants to stop the motor, he stops the crank; or if he wants the motor to run the other way he turns the crank the other way. With an ordinary regulating-commutator, if, for instance, the motor is to run faster, the operator must first reason that if he turns the arm to a certain point the desired result will ensue, after which he performs the operation, and so with all the other motions which may be necessary. Again, when a person is engaged in regulating a motor, his natural instinct, if he wants the motor to stop, is to stop what he is doing. He therefore, with the old methods, has first to overcome this desire, then to decide how to move his switch, and then to so move it; but with my invention he has simply to obey this instinct. It becomes to him as though he himself was rotating the motor or operating the driven mechanism, and he has to do simply what he would do if the crank he was turning did actually propel the car or move the gun or raise the elevator, as the case may be.

While my invention is adapted to electric motors in any situation where regulation is necessary, it is designed with especial reference to the use of electric motors in the training of heavy guns, which have to be moved sometimes in one direction and sometimes in the other, sometimes rapidly and sometimes slowly, and which must be started and stopped promptly. Here my invention possesses peculiar advantages, for in the midst of hurry and confusion and among disturbing circumstances the necessity of fumbling with a switch and deciding which way and how far to move it would render the regulation slow and uncertain, whereas by my invention the gunner is put in a position to feel that he is moving the gun itself, and the motor obeys his hand with movements entirely corresponding with his own, so that there is no occasion for thought on his part, and he, even though totally inexperienced or of a slow and inactive mind, can perform his duty with readiness and accuracy.

Apparatus embodying my invention is illustrated in the accompanying drawings, in which—

Figure 1 is an elevation of an electric motor

provided with such apparatus, and Fig. 2 a diagram of the regulating-resistance.

It is to be understood that the apparatus shown, while it is such as may be used, is intended principally for illustration, and may be modified in many ways without departing from the spirit of my invention.

A is the armature, and B the field-magnet, of an electro-dynamic motor, which may be of any suitable and efficient character. Brushes *a a'* bear on the commutator-cylinder C.

D is the armature-shaft. The field-magnet of the motor may be energized in any suitable way.

E is a drum or hollow wheel on a shaft, F, in line with the armature-shaft. This drum has external contact-plates, *b b'*, &c., separated by insulation, to which resistances *r r* within the drum are connected, in a manner to be presently explained. The shaft F has a pinion, G, upon it, with which engages a large toothed wheel, G', provided with a crank, H, for turning it. The shaft F and the crank-shaft are supported by a post or beam, I, or in any other suitable manner.

The wires 1 2 of the supplying-circuit are connected, respectively, to brushes *c c'*, which bear one on a sleeve or collar, *d*, carried by and insulated from the shaft F, the other on an uninsulated collar, *d'*, or, if desired, directly upon the shaft. A wire, *e*, extends from collar *d* to the interior of the drum E. Upon the periphery of the drum E two metal rollers, *f* and *f'*, bear, (or springs or brushes may be used instead,) which are carried by spring-arms *g* and *g'*, of metal, respectively, the arm *g* being connected directly with the shaft D, while the arm *g'* extends from an insulated collar, *h*, on the shaft. A brush, *i'*, bears on collar *h*, and a brush, *i*, on the shaft or on an uninsulated collar thereon. Brush *i* is connected in any suitable way, as indicated, to commutator-brush *a*, and brush *i'* is connected to commutator-brush *a'*.

The connections shown within the drum E are as follows: From shaft F connection is made directly to an external contact-plate, *b*. Plate *b* is connected to *b'* and plate *b'* to b^2 through resistance-coils *r r*. To plates b^3 and b^7 no connections are made. The wire *e* is connected to b^4. b^4 is joined to b^5 and b^5 to b^6 through other resistance-coils *r r*.

It will be seen that if the current-collectors *f* and *f'* are on b^3 and b^7 the circuit to the motor will be broken; if they are on b^4 and *b*, the motor-circuit will be closed through no resistance; if on b^5 and *b'*, the circuit will be through two resistance-coils, one on each side; if on b^6 and b^2, the circuit will be through all the resistance-coils; or if *f* and *f'* are reversed in their position on the drum the circuit will be reversed. There are thus provided two sets of contact devices—one carried by the motor, the other turned by hand—and these are connected through regulating devices in such manner that variations in their relative position affect the speed and direction of rotation of the motor.

It is evident that there may be a greater number of contact-plates and of divisions of the resistance, so as to permit of more exact regulation, if desired.

The operation of the apparatus is as follows: The motor being mechanically connected to any machine or mechanism which is to be driven or propelled thereby, the operator proceeds to turn the crank H, so as to revolve the shaft F at the same speed at which the armature-shaft is turning and in the same direction. The excessive size of the toothed wheel G' enables a slow motion of the crank to become a rapid one at the shaft F. It will be seen that so long as the two shafts run at the same speed the rollers *f f'* will remain in the same position on the surface of the drum E, to which they may have been originally adjusted. For instance, if they are placed on plates *b* and b^4 the motor will continue to run at its highest speed, there being no resistance in its armature-circuit, so long as the operator continues to turn the crank at the right speed; but if he wishes to lessen the speed of the motor he has simply to turn the crank more slowly, whereupon the more rapid rotation of the armature-shaft will carry the rollers *f f'* over to another part of the drum E—that is, to the plates *b'* and b^5—whereby portions of the resistance will be placed in circuit and the speed of the motor will be at once reduced, and it will run at this reduced speed until another change is necessary, when the crank may be turned either more slowly, so as to bring the rollers on b^2 and b^6 and put in more resistance, or more rapidly, so that the rollers, running more slowly than the drum, will go back to *b* and b^4. To stop the motor, the operator stops the crank, whereupon the armature will continue to turn for a moment until the rollers reach the plates b^3 and b^7, when the circuit will be broken and the motor will stop. To reverse the direction of rotation of the motor, the motion of the crank is reversed, whereupon the drum E will be shifted at once, so as to bring the rollers into opposite positions on the drum and so reverse the direction of the armature-current, and the operator then continues his movement in the new direction fast or slow, according to the speed required of the motor.

While I have shown and described my invention as acting by throwing resistance-coils into and out of the armature-circuit, it is evident that it may be as well employed with other known modes of regulating the speed of motors—as by throwing resistance into and out of the field-circuit of the motor. Further, the resistance-coils in the armature or field circuit need not be carried by the drum, but may be stationary and connected with suitable commutator-plates having sliding connections with the drum or shaft, which connections are affected by the changes in the

relative speed of the two shafts. In this way also the apparatus may be made to act by cutting out or throwing in sections of coils on the field-magnet.

What I claim is—

1. The combination of an electric motor, mechanism adapted to be moved by hand, and regulating apparatus for said motor affected by the movements both of said motor and of said hand mechanism, whereby variations in the relative speed or the relative direction of movement of said motor and said hand mechanism produce variations in the speed or direction of movement of the motor, substantially as set forth.

2. The combination of an electric motor, means for regulating its speed or direction, or both, and two sets of contact devices, variations in whose relative position affect said regulating means to vary the speed or direction of the motor, one set of contact devices being arranged to be moved by the motor and the other to be moved by hand, substantially as set forth.

3. The combination of an electric motor, a body adapted to be moved by hand, contacts carried by said body, between which a circuit to the motor is completed, and terminals for said circuit adapted to be moved by the motor and to bear on said contacts, whereby when said terminals are removed from said contacts the circuit is broken, substantially as set forth.

4. The combination of an electric motor, a body adapted to be moved by hand in either direction, contacts carried by said body between which a circuit to the motor is completed, and terminals for said circuit adapted to be moved by the motor and to bear on said contacts, whereby the reversal of the movement of said hand-moved body reverses the current in said circuit, substantially as set forth.

5. The combination of an electric motor, means for regulating its speed or direction, or both, and two sets of contact devices, variations in whose relative position affect said regulating means to vary the speed or direction of the motor, one set of contact devices being arranged to be continuously rotated by the motor and the other to be continuously rotated by hand, substantially as set forth.

6. The combination of an electric motor, a rotating body adapted to be revolved by hand, a series of contacts carried by said rotating body, terminals of a circuit-supplying current to the motor carried by the motor-shaft and bearing on said contacts, and resistance-coils in the circuit between said contacts, whereby variations in the position of said terminals upon said contacts causes a variation of the resistance in circuit, substantially as set forth.

7. The combination of an electric motor, a rotating body adapted to be revolved by hand, contacts carried by said rotating body between which a circuit to the motor is completed, and terminals for said circuit carried by the motor-shaft and adapted to bear on said contacts, whereby when said terminals are removed from said contacts the circuit is broken, substantially as set forth.

8. The combination of an electric motor, a rotating body adapted to be revolved by hand in either direction, contacts carried by said rotating body between which a circuit to the motor is completed, and terminals for said circuit carried by the motor-shaft and adapted to bear on said contacts, whereby the reversal of the movement of said rotating body reverses the current in said circuit, substantially as set forth.

9. The combination of an electric motor, a rotating body, contacts carried by said rotating body, terminals of a circuit to the motor carried by the motor-shaft and bearing on said contacts, and regulating devices affected by variations in the position of said terminals upon said contacts to vary the speed or direction of motion of the motor, a handle for turning said rotating body, and gearing between said handle and said rotating body for converting a slow movement of said handle into a rapid movement of said rotating body, substantially as set forth.

10. The combination of an electric motor, a rotating body adapted to be revolved by hand and carrying a series of contact-plates, two of said contact-plates being disconnected from each other, two being joined through no resistance and others being joined through resistances, and terminals of a circuit to the motor carried by the motor-shaft and bearing on the surface of said body, substantially as set forth.

This specification signed and witnessed this 25th day of June, 1887.

BRADLEY A. FISKE.

Witnesses:
WILLIAM PELZER,
E. C. ROWLAND.