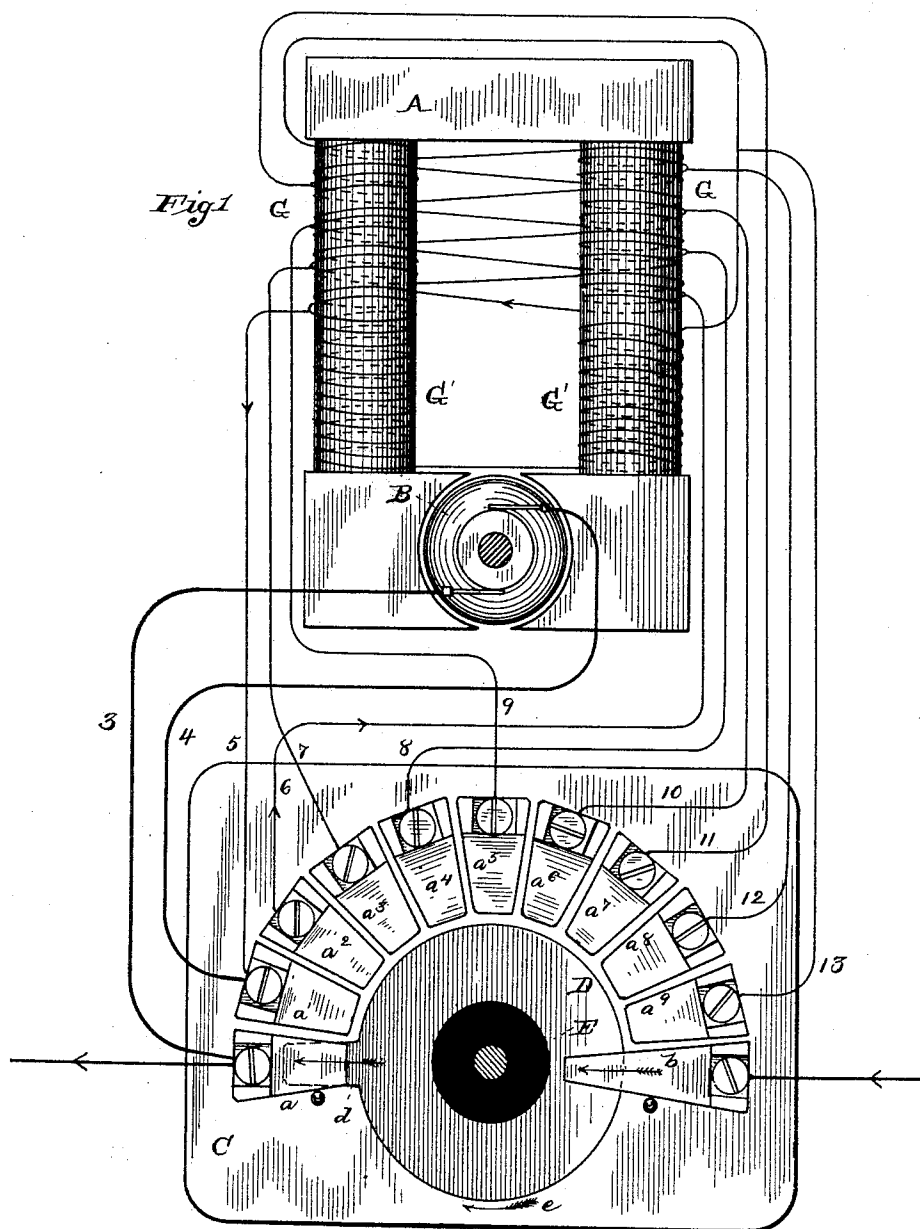


F. J. SPRAGUE.
ELECTRO DYNAMIC MOTOR.

No. 337,793.

Patented Mar. 9, 1886.



ATTEST.
Edw. Rowland
Plt. Clerk

INVENTOR:
Frank J. Sprague
By O. J. ...
att'y

(Model.)

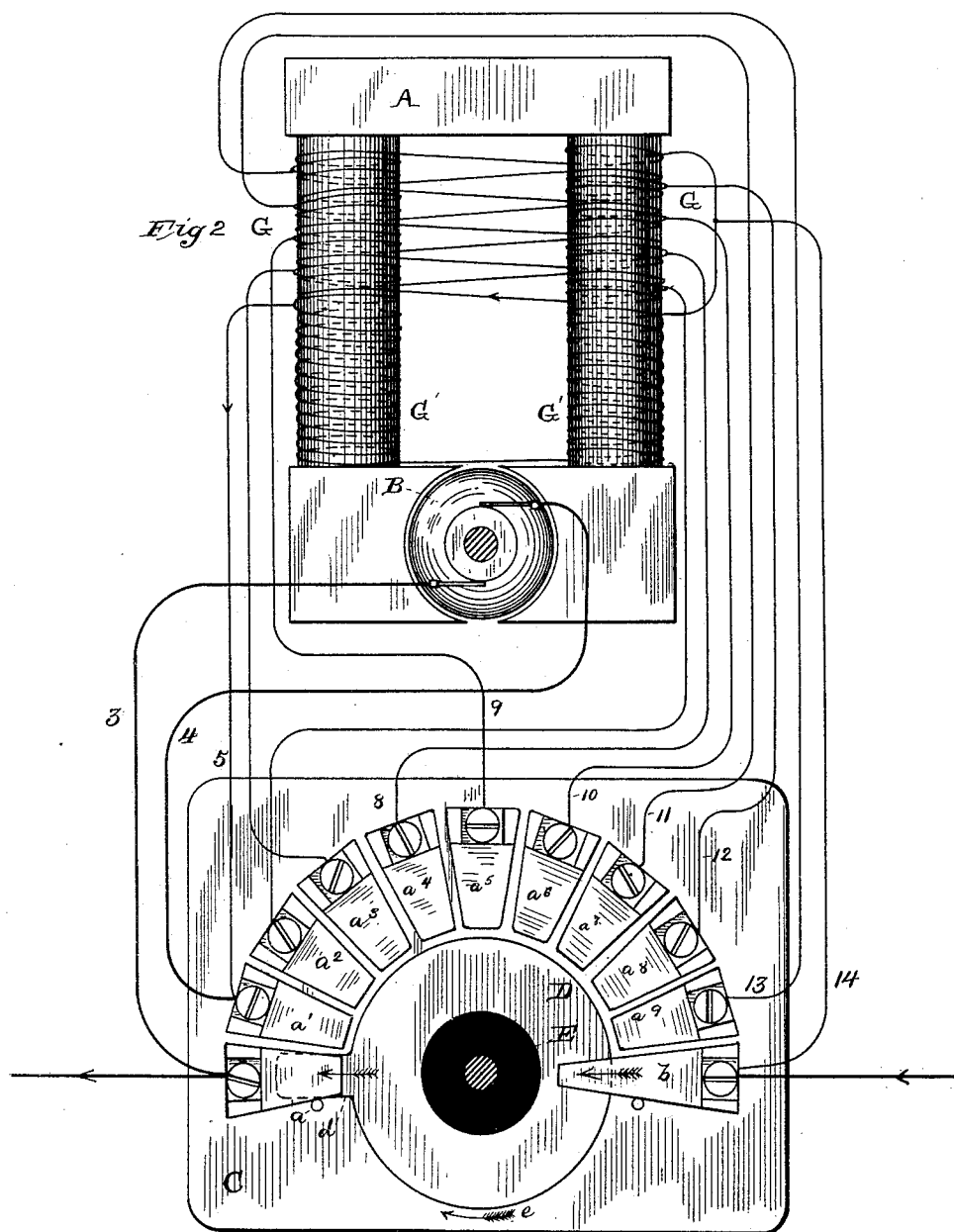
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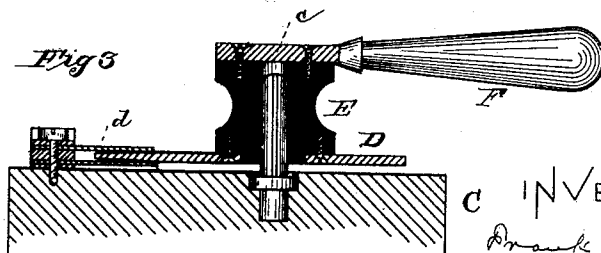
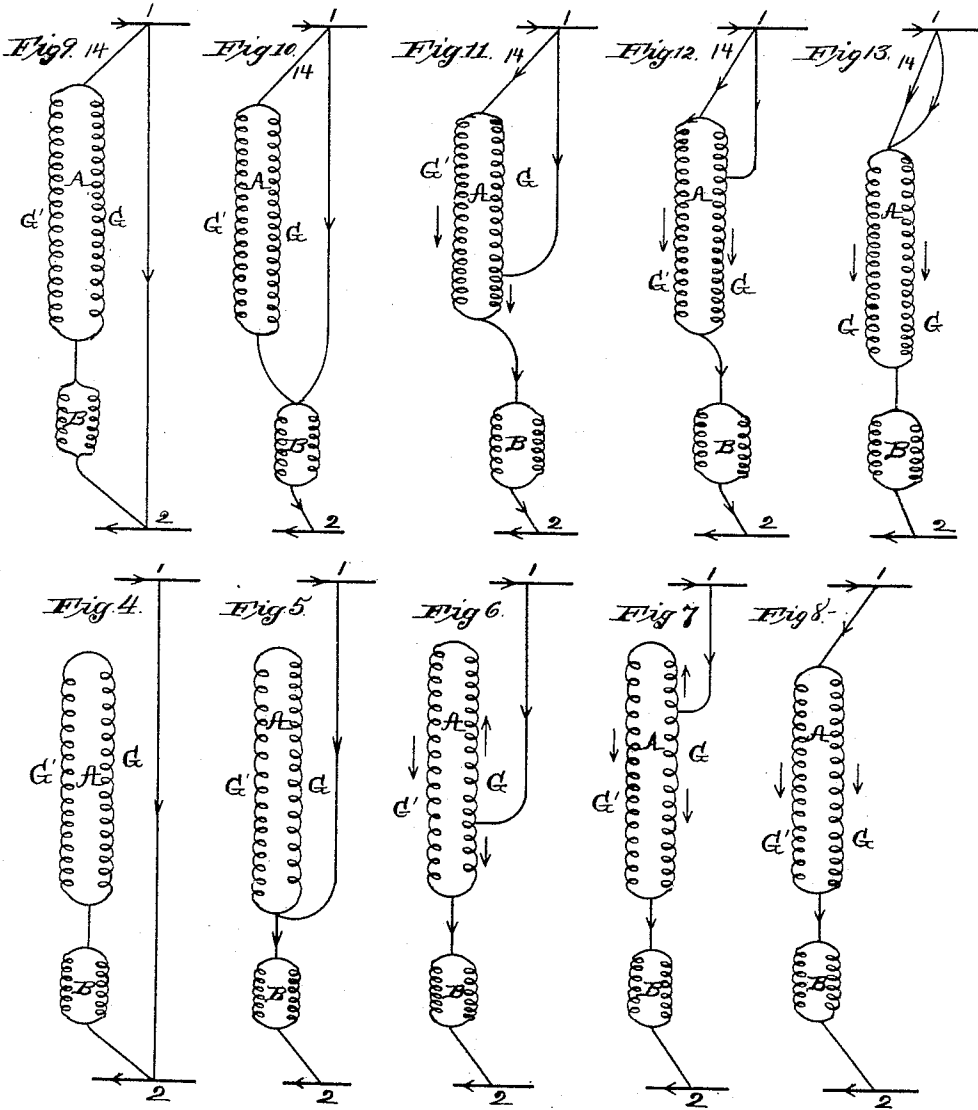
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ATTEST:
E. P. R. and
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UNITED STATES PATENT OFFICE.

FRANK J. SPRAGUE, OF NEW YORK, N. Y.

ELECTRO-DYNAMIC MOTOR.

SPECIFICATION forming part of Letters Patent No. 337,793, dated March 9, 1886.

Application filed July 6, 1885. Serial No. 170,734. (No model.)

To all whom it may concern:

Be it known that I, FRANK J. SPRAGUE, of New York, in the county and State of New York, have invented a certain new and useful Improvement in Electro-Dynamic Motors, of which the following is a specification.

This invention relates to the regulation of electro-dynamic motors used upon circuits of constant current, such as circuits in which are lights are arranged in series. The motors best adapted for this use are those in which the armature and main field-coils are connected in series. When such a motor is not in use, the circuit must be closed around it to the other motors or lamps in series with it, and when the motor is placed in circuit for use it is desirable to first place the armature in circuit without the field-magnet, so that the whole resistance of the motor will not be suddenly thrown upon the line, and then to throw in the field-coils gradually, so as to gradually bring their resistance into the circuit, and at the same time gradually increase the strength of field and bring up the speed of the motor—this, it will be remembered, being a constant-current circuit—to the desired point, and when the motor is running its speed is to be regulated by varying the strength of the field.

The object of my invention is to provide a machine combined with a switch or commutator by which all the steps above set forth may be readily performed. In accomplishing this I wind the field-magnet coils in a continuous closed series, and make connections from certain points on said coils to blocks of the switch. A pivoted arm of said switch forms a terminal of the supplying-circuit, and is so arranged that in one position it is connected directly across to the other terminal, so short-circuiting the whole motor. In another it is connected between the field-magnet and armature, thereby throwing in the armature and leaving the field-magnet short-circuited, while in others it is connected to different points of the continuous field-coil series, thereby placing in circuit different resistances of said coils, and reversing the current in a greater or less number of said coils, so that the resistance may be thrown in gradually, and the strength of the field-magnet may be regulated by the variation in the magnetizing effect of said coils.

My invention is illustrated in the annexed

drawings, in which Figure 1 is an elevation of the motor and plan view of the switch with its turning spindle in section and a diagram of the connections; Fig. 2, a similar view showing a switch with a somewhat modified connection; Fig. 3, a vertical section of the switch. Figs. 4, 5, 6, 7, and 8 are diagrams showing the different connections made by means of the switch in Fig. 1, and Figs. 9, 10, 11, 12, and 13 are similar diagrams for the switch of Fig. 2.

A is the field-magnet, and B the armature, of an electro-dynamic motor. The switch is composed of an insulating-base, C, which carries a number of short contact-blocks, a , a' , a'' , &c., and one longer contact-block, b . The moving contact is a metal disk, D, encircling an insulating-block, E, on a spindle, c , and provided with a projecting arm, d . The insulating-block E has attached to it a handle, F, for turning the disk to bring the arm d into contact with the different contact-blocks. The long contact b is always in contact with the disk.

Each contact preferably consists of two spring-fingers, as shown in Fig. 3, between which the disk or its projecting arm enters to make contact with them.

Referring more particularly to Figs. 1, 4, 5, 6, 7, and 8, half the coils G of the field-magnet are wound in sections, all these sections being joined together, and with the sections G' to form a continuous closed circuit. 1 2 are the terminals of the supplying constant-current circuit. Terminal 1 is connected with long contact-block b directly, and therefore is constantly connected with the moving contact d . Terminal 2 is directly connected with the first contact, a . One commutator-brush is connected by wire 3 with contact a ; the other by wire 4 with contact a' . The sectional coils G are successively connected by wires 5 6 7 &c., with the blocks a' to a'' , respectively.

In the first position of the switch shown in Figs. 1 and 4, current is from long contact b , directly across the movable disk to contact a , and thus the whole motor is short-circuited. Turning the disk in the direction indicated by arrow e (all the other arrows show direction of current) brings arm d into contact with block a' . The circuit is then from b to a' , wire 4 to the armature-wire 3 to a , and

thence to the line. This brings the armature into circuit, but leaves the field-magnet still short-circuited, the motor being then as in Fig. 5. Moving arm *d* to contact *a'* brings the motor as shown in Fig. 6, the circuit being by wire 6 to coils G, where it divides, part of the current going direct through a small portion of the field-coils G to wire 5, back to *a'*, through the armature, and out on the line, while the rest goes in the reversed direction through the rest of the coils G, also to wire 5, *a'*, and the armature. This it is evident produces only a small magnetizing effect, and places only a part of the resistance of the field-coils in circuit. Continuing the movement of arm *d*, so as to bring it successively in connection with the different contact-blocks, increases the number of sections G in which the current is direct, and decreases those in which it is reversed, and also increases the resistance of the circuit of the direct coils G, whereby the magnetizing effect of all the coils is varied largely by a small movement of the commutator. This effect of a changed position of the commutator-arm is illustrated in Fig. 7. When arm *d* reaches contact *a'*, the motor is as shown in Fig. 8, with all the coils G in circuit direct, and likewise all the coils G', the two sets or ranges of coils being in parallel circuit to each other. The circuit in this arrangement in Fig. 1 is block *b*, block *a'*, wire 13 to the field-coils, where the current branches, part going around all the coils G to wire 5, and thence to block *a'*, wire 4, armature, wire 3, and out on the line, and the other part going through all the coils G' to wire 5, and so on out.

In the arrangement shown in Figs. 2, 9, 10, 11, 12, and 13, in addition to the connections above set forth, there is a wire, 14, which extends from the block *b*, or, in other words, from the terminal 1 to between the two field-coil ranges G and G'. This is a permanent connection, as seen in the diagrams. The movement of the commutator changes the connection of terminal 1 in the manner described above. The wire 14, however, causes an additional direct effect to be produced in all the coils and lowers the whole resistance of the coils.

What I claim is—

1. The combination, with a series motor, of a movable terminal of the supplying-circuit, a contact therefor whereby the whole motor may be short-circuited, and a contact whereby the field-magnet alone may be short-circuited, substantially as set forth.

2. The combination, with a series motor, of a movable terminal of the supplying-circuit, a contact therefor whereby the whole motor may be short-circuited, and contacts whereby said terminal may be connected to differ-

ent points of the field-magnet coils, substantially as set forth.

3. The combination, with a series motor, of a movable terminal of the supplying-circuit, a contact therefor whereby the whole motor may be short-circuited, a contact whereby the field-magnet alone may be short-circuited, and contacts whereby said terminal may be connected to different points of the field-magnet coils, substantially as set forth.

4. An electro-dynamic motor having its field-magnet coils in a continuous closed circuit, in combination with one terminal of the supplying-circuit having a fixed connection with said field-coils, and the other terminal movable for connection with different points of said field-coils, substantially as set forth.

5. The combination, with a series motor, of a switch having a stationary contact forming one terminal of the supplying-circuit, a stationary contact connected with the first contact through the armature, stationary contacts connected with different parts of the field-magnet coils, and a movable contact forming the other terminal of the supplying-circuit, and adapted to be brought into connection with the stationary contacts successively, substantially as set forth.

6. The combination, with a series motor, of the movable terminal of the supplying-circuit, adapted to short-circuit the motor, to short-circuit the armature alone, and to be connected to different points of the field-magnet coils, and an additional fixed connection from the same terminal of the supplying-circuit to the field-magnet coils, substantially as set forth.

7. An electro-dynamic motor having part of its field-magnet coils in sections connected at intervals with blocks of a switch, and all its field-magnet coils joined together in a continuous closed circuit, in combination with a terminal of the supplying-circuit permanently connected between the sectional and the regular coils, and a movable arm of the switch forming the other terminal of the supplying-circuit, substantially as set forth.

8. In an electrical switch, the combination of a series of contacts, a revolving metal disk having a projection engaging with said contacts successively, and another contact constantly engaging with said disk, substantially as set forth.

This specification signed and witnessed this 2d day of May, 1885.

FRANK J. SPRAGUE.

Witnesses:

A. W. KIDDLE,
E. C. ROWLAND.