No. 646,526. Patented Apr. 3, 1900.

J. C. LINCOLN.

ELECTRIC CONTROLLER.

(Application filed July 24, 1899.)

(No Model.) 4 Sheets—Sheet 1.

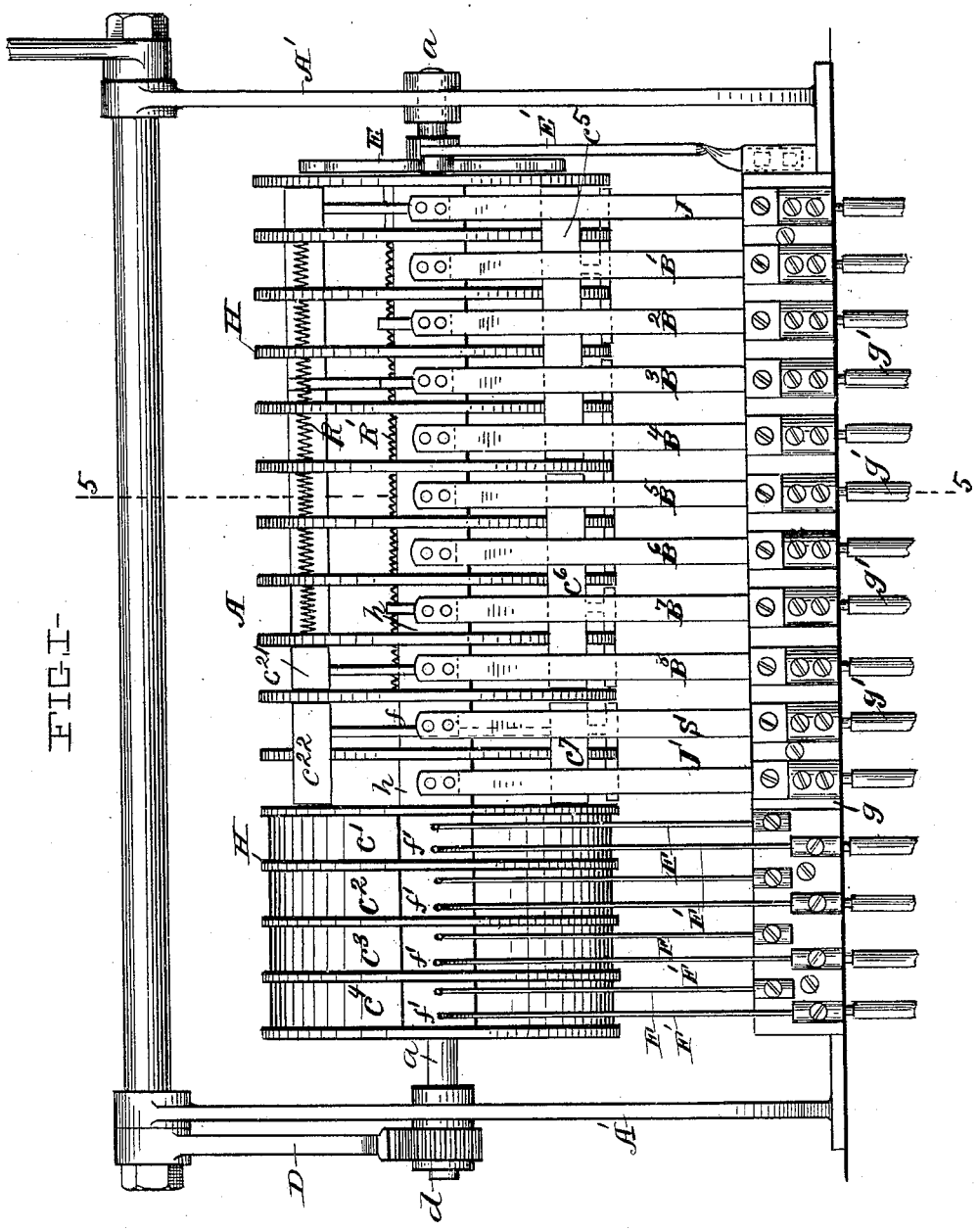


FIG. 1.

Witnesses,
J. C. Turner
C. A. Henderson

Inventor,
John C. Lincoln
By A. A. Austin.
Atty.

No. 646,526. Patented Apr. 3, 1900.

J. C. LINCOLN.

ELECTRIC CONTROLLER.

(Application filed July 24, 1899.)

(No Model.) 4 Sheets—Sheet 2.

FIG. 1.

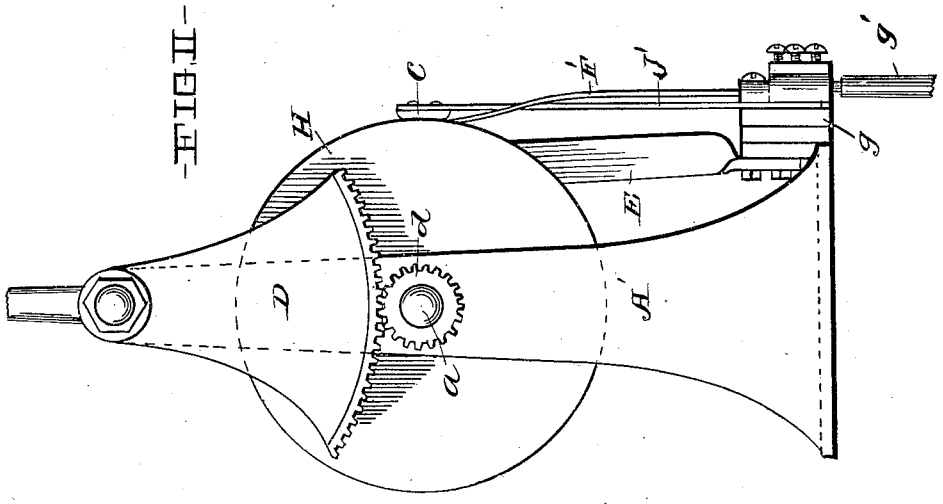
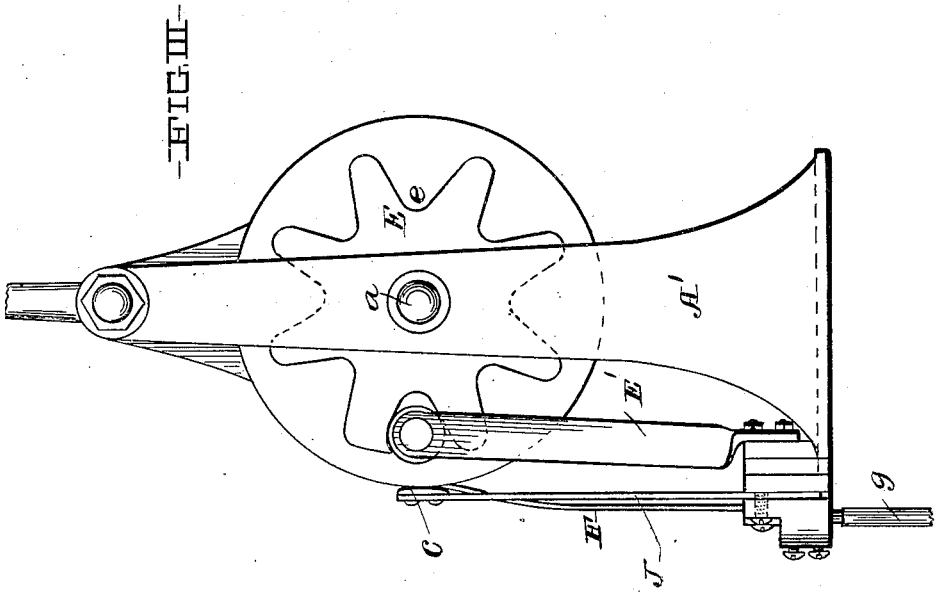


FIG. 2.



Witnesses,
J. C. Turner
C. D. Henderson.

Inventor
John C. Lincoln.
By
Allen Austin.
Atty.

No. 646,526. Patented Apr. 3, 1900.

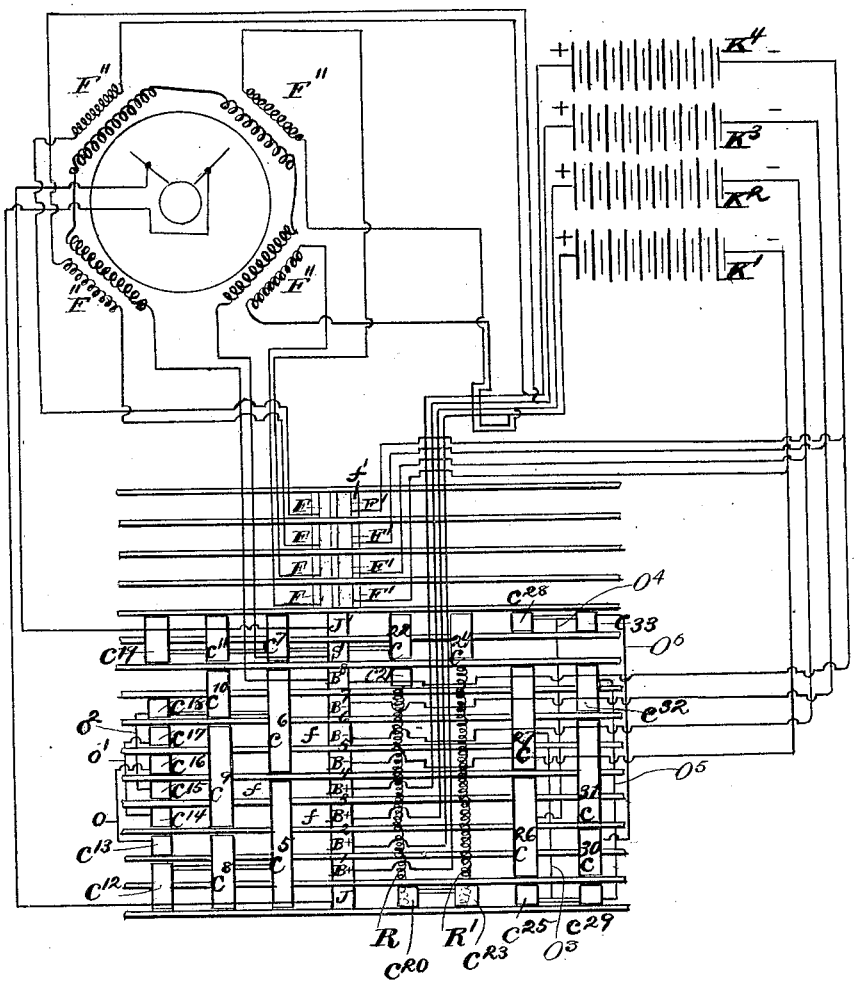
J. C. LINCOLN.

ELECTRIC CONTROLLER

(Application filed July 24, 1899.)

(No Model.) 4 Sheets—Sheet 3.

-FIG. IV-



Witnesses,
J. C. Turner
C. L. Henderson

Inventor
John C. Lincoln
By Ann Austin
Atty.

No. 646,526. Patented Apr. 3, 1900.

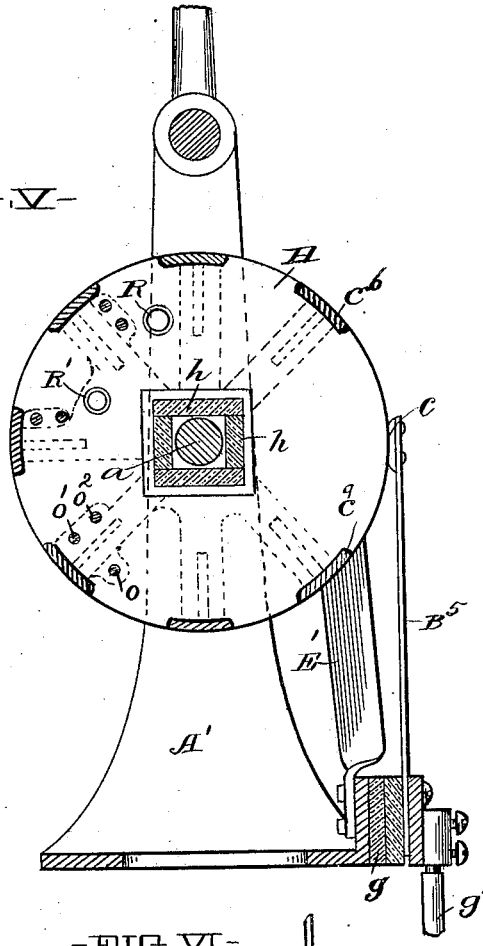
J. C. LINCOLN.

ELECTRIC CONTROLLER.

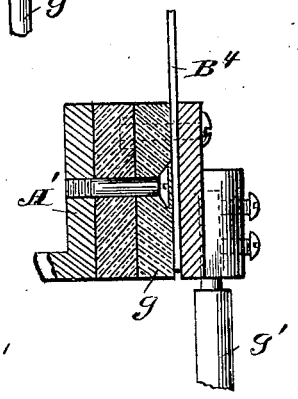
(Application filed July 24, 1899.)

(No Model.) 4 Sheets—Sheet 4.

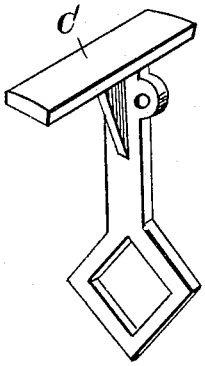
-FIG. V-



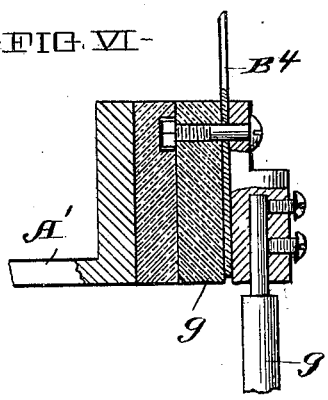
-FIG. VII-



-FIG. VIII-



-FIG. VI-



Witnesses
J. C. Turner
C. A. Henderson.

Inventor,
By John C. Lincoln.
Am Austin.
Atty

UNITED STATES PATENT OFFICE.

JOHN C. LINCOLN, OF CLEVELAND, OHIO.

ELECTRIC CONTROLLER.

SPECIFICATION forming part of Letters Patent No. 646,526, dated April 3, 1900.

Application filed July 24, 1899. Serial No. 724,919. (No model.)

To all whom it may concern:

Be it known that I, JOHN C. LINCOLN, a citizen of the United States of America, residing at Cleveland, county of Cuyahoga, State of Ohio, have invented certain new and useful Improvements in Electric Controllers, of which the following is a specification.

The annexed drawings and the following description set forth in detail one construction embodying my invention, said detailed construction being but one of various mechanical forms in which the principle of the invention may be used.

In said drawings, Figure I represents a side elevation of my improved controller, showing same in its non-operative position. Figs. II and III represent end views of the same, showing means for rotating the cylinder and for holding same in its adjusted position. Fig. IV represents a diagram of the controller and its connections with the batteries and the motor. Fig. V represents a transverse cross-section of the controller through the line 5 5 of Fig. I. Figs. VI and VII represent cross-sectional views of the connection between the wires and the terminals. Fig. VIII represents a detail showing the construction of the contacts.

The cylinder A of my improved controller is formed with a central shaft *a*, that is journaled in suitable bearings provided by the frame A'. Said shaft is provided at one end with a pinion *d*, adapted to mesh with suitable gearing D, whereby the cylinder is rotated. At its other end the shaft is provided with a detent-wheel E, having notches *e* formed in its periphery adapted to engage with a yielding pawl E' to hold the cylinder in its adjusted position. Contacts C' to C^4, consisting of strips of conducting material, such as brass, are arranged at one end of the cylinder and extend partly around same. Contacts C^5 to C^{33}, of similar material, are arranged in rows parallel with the axis of the cylinder that register with the notches formed on the detent-wheel. Said contacts are secured to the central shaft and are insulated therefrom by means of insulating-sleeves *h* and are insulated from each other by means of insulating-collars H. Suitable spaces *f'* are formed between the adjacent ends of contacts C' to C^4 and spaces *f* between the rows of contacts.

The controller is arranged to be used with a motor provided with a shunt winding or windings F'' and two or more battery-cells or crates of batteries consisting of several cells suitably connected or other independent sources of electrical energy, and I have herein shown same in combination with a compound-wound motor and four crates of battery-cells. Terminals consisting of strips of brass or similar conducting material provided with contact-points *c* are preferably secured to the frame and are arranged so as to connect with the rows of contacts provided upon the cylinder. Said terminals are insulated *g* from the frame and are suitably connected to the wires *g'*, that are connected with the windings of the motor and the poles of the batteries. The terminals F and F' of each of the shunt-windings are arranged to connect with one of the contacts C' to C^4, that are placed at one end of the cylinder. One terminal of the armature-winding, J', is arranged next the shunt-terminals, and the other armature-terminal, J, is arranged near the other end of the controller. Terminals B', B^2, B^3, and B^4, suitably connected with the positive poles of the batteries K', K^2, K^3, and K^4, respectively, are arranged next to said armature-terminal J. Terminals B^5, B^6, B^7, and B^8, connected with the negative poles of said batteries, are arranged next to the positive terminals, and the terminals of the series winding S and B^8 are arranged between said negative terminals and armature-terminal J', the negative terminal of batteries K^4 and one end of the series winding being the same.

In the controller's non-operative position the terminals seat in the recesses *f* and *f'*, provided between the contacts. When the cylinder is rotated in either direction, the shunt-terminals engage with the shunt-contacts and remain in connection therewith until the controller is returned to its non-operative position, thereby providing a constant field for the motor regardless of the changes in the voltage supplied to the armature. When the controller is rotated in its "ahead" position, the terminals, except the shunt-terminals, engage with the first row of contacts

C^5, C^6, and C^7. The path of the current is from contact C^5 through the armature to contact C^7, through the series coil to contact C^6, and via the batteries to contact C^5, thus connecting the batteries in parallel. If the controller is rotated another notch in the ahead direction, the terminals connect with the second row of contacts consisting of C^8 to C^{11}. The path of the current is through the contact C^8 via the armature to contact C^{11}, through the series windings to contact C^{10}, via batteries K^3 and K^4 to contact C^9, and then through batteries K′ and K^2 to contact C^8. To arrange the batteries in series, the controller is rotated another notch until the terminals connect with the third row of contacts consisting of contacts C^{12} to C^{19}. Contact C^{13} is connected with C^{16} by means of a rod O, C^{14} with C^{17} by a rod O′, and C^{15} with C^{18} by a rod O^2. Being thus connected, the current passes from contact C^{12} through the armature to contact C^{19}, through the series coil to terminal B^8, connected with the negative pole of battery K^4, then through the batteries K^4, K^3, K^2, and K′ successively, returning to contact C^{12}. To stop the armature, the cylinder is returned to its non-operative position and then rotated "back" until the armature and series terminals connect with contacts C^{20}, C^{21}, and C^{22}. Contacts C^{20} and C^{21} are connected by the resistance-wire R, thereby cutting out the batteries. As a constant field is provided by the shunt-circuit the rotation of the armature causes same to generate current, thus retarding its motion. To stop the armature quickly, the controller is rotated so that the armature-terminals connect with contacts C^{23} and C^{24}, that are connected by the resistance-wire R′, thereby cutting out the series coils as well as the batteries. The strength of the field is thus increased, and consequently the current generated by the armature, so that the motion of the armature is rapidly checked. To reverse the motion of the armature, the controller is rotated farther backward, so as to connect the terminals with contacts C^{25} to C^{28}. Contact C^{25} is connected with C^{27} by a rod O^3 and contact C^{26} with C^{28} by a rod O^4. The path of the current is from contact C^{26}, that is connected with the armature-terminal J′ by the rod O^3, through the armature to connect contact C^{25}, that is connected by the rod O^4 to contact C^{27}, thence through the batteries to contact C^{26}. The batteries are thus connected in parallel, but the direction of the current through the armature is reversed, thereby reversing its motion. To increase the speed of the armature in its reverse direction, the terminals are connected with C^{29} to C^{33}, thereby arranging the batteries in series parallel. Contact C^{29} is connected with C^{32} by a rod O^5, and contact C^{30} is connected with C^{33} by a rod O^6. The path of the current is from contact C^{30} via rod O^5 to contact C^{33}, through the armature to contact C^{29} via rod O^6 to contact C^{32}, through batteries K^3 and K^4 to contact C^{31}, and through batteries K′ and K^2, returning to contact C^{30}.

When the arrangement of the batteries is changed from series to series parallel or from series parallel to parallel, the armature tends to rotate at its former rate of speed. As the field remains practically constant, the only variation being caused by the series coil, current will be forced into the batteries whenever the electromotive force generated by the armature exceeds the electromotive force being supplied by the batteries. The motor is thus transformed automatically into a dynamo and forces current into the batteries until the speed of the armature is reduced, so that the electromotive force supplied by the batteries exceeds the electromotive force generated by the motor. The process of charging the batteries also occurs whenever the armature is accelerated by external means. The series winding in no way affects the automatic changes in the motor, which result entirely from providing the armature with a constant or practically constant field. In practice, however, it is desirable to use a series winding, as it prevents jerking or sudden retardation when the voltage supplied to the armature is reduced.

If the controller is applied to an electric vehicle, the change to a slower rate of speed or the acceleration of the armature due to the increased motion of the vehicle upon a downgrade can be caused to generate electric energy that may be stored in the batteries. The batteries can thus be used much longer without recharging than is otherwise possible, thereby permitting a greater distance to be traveled with a given number of batteries.

Various changes within the skill of the mechanic may be made as regards the mechanism herein disclosed without departing from my invention provided the means covered by any one of the following claims is employed.

I claim as my invention—

1. The combination with two or more battery-cells and a motor having its field provided with a series coil and a shunt-coil, of means for supplying a varying voltage from said cells to the armature and series coil and a constant voltage to the shunt-coil of said motor, substantially as described.

2. The combination with a plurality of terminals electrically connected with two or more battery-cells and a motor having a field provided with two or more shunt-coils, of a controller provided with two or more contacts arranged to successively connect with the terminals of said battery-cells to vary the connection between said cells, and with contacts arranged to continuously connect each of said cells with one of said shunt-coils in the controller's operative position, substantially as described.

3. The combination with two or more battery-cells and a motor having its field provided with a series coil and a shunt-coil, of a controller electrically connected with said

cells and motor, said controller being provided with means for supplying a varying voltage to said motor and series coils, and providing a constant voltage to said shunt-coil, substantially as described.

4. The combination with a plurality of terminals electrically connected with two or more battery-cells and with a motor having a field provided with a series coil and one or more shunt-coils, each of said shunt-coils being connected with one of said batteries, of a controller provided with two or more contacts arranged to engage successively with the terminals of said batteries to vary the voltage supplied to the armature of said motor and to said series coil, and with contacts continuously engaging the terminals of said shunt-coils in the controller's operative position to provide a constant voltage through each of said shunt-coils, substantially as described.

In testimony whereof I sign this application, in the presence of two witnesses, this 17th day of July, 1899.

JOHN C. LINCOLN.

Witnesses:
STEPHEN D. SANOR,
C. I. HENDERSON.