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J. F. McELROY.

ELECTRIC LIGHTING SYSTEM.

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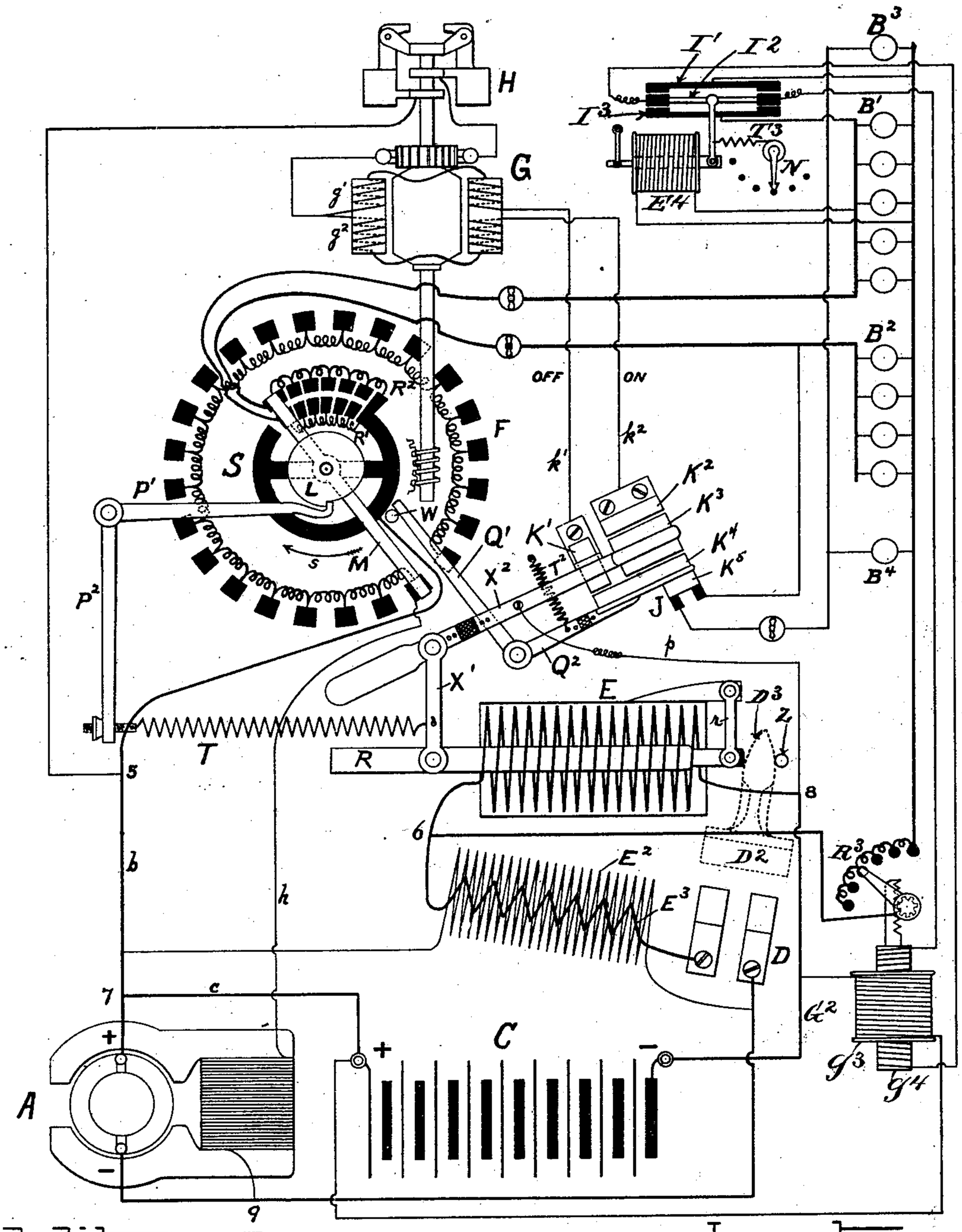
NO MODEL.



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ELECTRIC-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 720,609, dated February 17, 1903.

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To all whom it may concern:

Be it known that I, JAMES F. MCELROY, a citizen of the United States, residing at Albany, county of Albany, and State of New York, have invented certain new and useful Improvements in Electric-Lighting Systems, of which the following is a specification, reference being made to the accompanying drawing, which illustrates in diagram one of the various forms which the invention may assume.

My system is one in which a variable-speed dynamo—such, for instance, as one connected to and driven by an axle of a car or train—is employed to operate electric lamps on the said car or train and at the same time to charge a storage battery in multiple with the lamps for use in operating the lamps when the car or train is standing still or running at a very low speed. In systems of this general character it has been heretofore proposed to cause the dynamo to generate a constant volume of current, which current would divide itself between the electric lamps and the storage battery in multiple, according to the resistance of the respective lamp and battery branches. To this end a magnet has been included in the main unbranched circuit leading from the dynamo and so arranged as to regulate the dynamo to reduce the current volume in the event of its tending to exceed the normal fixed amount by reason of increase in the speed of the dynamo or a decrease in the total resistance of the lamp and battery branches, or, on the other hand, to increase the current if it should tend to fall below the normal fixed amount, either by reason of a decrease in the dynamo speed or an increase in the total resistance of the lamp and battery branches. In such a system, however, the inclusion of the regulating-magnet in the main circuit, so that it receives the total current (both that flowing to the lamps and that flowing to the battery) tends to give a fixed total of current, whereas in practice a variable current is required, according to the number of electric lamps in circuit at any time, while if a constant current volume is to be maintained in any part of the system it should be in the storage-battery branch and not in the lamp branch, since the lamps not only vary in number, but may be cut out altogether. In the latter event the battery would receive too great a current if the total volume were a fixed quantity.

In my present invention I employ a magnet in the battery-circuit which is in series with the battery, though in shunt to the lamps, and which will regulate the dynamo in accordance with the current flowing through the said circuit, which will be held constant, although the lamp-current will still vary automatically, as it does in a system of a different type wherein the dynamo is regulated by a potential-magnet that fixes the pressure or potential of the dynamo without regard to the flow of current. I thus place the regulator controlling not in the undivided portion of the main circuit, as formerly, but in the branch of the main circuit which leads to the battery, and it is a series magnet, so far as the battery is concerned, and regulates by current, not by potential. As a result of this location of the said magnet I maintain constant only that portion of the current which is applied to the battery, leaving the portion which goes to the lamps to be adjusted automatically according to the resistance of the lamp-circuit. The pressure or potential applied to the lamps will of course be determined by the total resistance of the battery-circuit in multiple with the lamp-circuit and will be variable to a degree, although perhaps not sufficiently so to render the lamps inoperative. I prefer, however, to provide an automatic resistance in the lamp-circuit controlled by a shunt-coil in multiple with the lamps, which will indicate the pressure on the lamps and also increase or decrease the said resistance to maintain said pressure constant.

Referring to the accompanying drawing, A represents a dynamo-electric machine which is understood to be operated at a variable speed—as, for instance, by a driving connection between it and the axle of a car or train. The circuit from this dynamo, starting from the positive brush, branches at the point 7, one branch going by the wire *b* to a ring S of a regulating-rheostat and thence by the contact-arm M to the groups of lamps B′ and B², returning therefrom to the point 6. The other branch, starting from the point 7, goes by the wire *c* to the battery C, thence through the magnet E to the point 6 aforesaid. After re-

uniting the two branches go together to the coil E^3, consisting of a few turns of coarse wire upon the same core with the shunt-coil E^2. Thence it goes to the automatic connection-switch D, which is connected to the opposite or negative terminal of the dynamo A. It is thus apparent that the lamps and the battery when the connection-switch D is closed are connected in multiple to the dynamo and that the regulating-magnet E is contained in the battery branch. It is not necessary to describe the automatic connection-switch D, since it is referred to in various other applications made by me and constitutes no part of the present invention, it being understood, however, that the closure of the said switch is determined by the pressure or potential of the dynamo when it reaches a given speed, such pressure or potential being indicated by the shunt-coil E^2, which acts to close the switch D when the potential is of the proper value and to open it again when the pressure falls below that value. The opening of the switch is made positive by the presence of the coarse-wire coil E^3, which acts in opposition to the shunt-coil E^2 when the speed of the dynamo decreases and its pressure becomes slightly less than that of the battery, so that a reverse current flows through the said coil E^3 from the battery in opposition to the shunt-coil E^2. Assuming now that the switch D is closed, I will now describe the method in which the series coil E in the battery branch serves to control the regulation of the dynamo so as to maintain the current in the said coil and in the storage battery constant. The dynamo A has its field-magnet coil contained in a shunt-circuit starting from the point 9, which is immediately connected to the negative brush of the dynamo and passes to the field-magnet of the machine and thence by the wire *h* to the rheostat F, which is entirely cut out of the field-magnet circuit in the position shown in the diagram, but which will be included therein to a greater or less extent as the contact-arm M moves from its "off" or "zero" position shown in the drawing toward its "on" position, following the direction of the arrow *s*. The field-magnet circuit aforesaid passes from the contact-arm M of the rheostat to the ring S, and thence by the wire *h* to the opposite terminal of the dynamo, including, as aforesaid, so much of the resistance F as may be determined by the position of the contact-arm M. This constitutes the regulator for the dynamo, and it is controlled by the magnet E through the intervention of motor G, whose direction of movement is determined by the said magnet E.

The motor G operates the rheostat-arm M by any desired means—such, for instance, as a worm-and-screw gear, which is indicated in the diagram. The motor G is contained in a shunt-circuit from the storage battery which starts from the wire *b* at the point 5 and proceeds to the centrifugal circuit-breaker H, thence to the motor-armature, and thence through one or the other of two oppositely-wound field-magnet coils g' and g^2 and by the wire k' or the wire k^2 to the contact K′ or K^2, from one or the other of which the circuit passes to the contact K^3 and thence by the wire *p* to the point 8, where it joins the main wire, leading to the negative terminal of the battery. The motor is thus operated by the battery instead of by the dynamo in order that the regulator may be brought to its zero or off position by the battery-current in the event of any sudden interruption of the dynamo-current by the blowing of a fuse or other contingency, and in order that the battery-current through the motor G may be finally broken I provide that when the rheostat comes to its off or zero position the pin W will strike the lever-arm Q′, and thereby throw the contact K^4 out of connection with K′, the former being carried by the lever-arm Q^2. When, however, the rheostat again starts, the pin W comes out of engagement with the lever-arm Q′ and allows the spring T^2 to throw the contact K^4 against the contact K′, and thereby permit the current to flow to the motor through one or the other of its field-magnet coils, according as the contact K^3 delivers the current from the wire *p* to the contact K^2 or to the contact K^4. The controller-magnet E has its core R supported at one end by a link *r* and at the other end by a lever-arm X′, which is rigidly connected with the lever X^2, operating the aforesaid contact K^3. The magnet E tends to draw in its core R against the force of the retracting-spring T, the said spring in the conditions shown in the diagram being adjusted to cause the magnet to respond to a smaller current than is normally contemplated in the battery branch—that is to say, the magnet E is with respect to the lamps a potential or shunt magnet and should start the regulator to throw resistance into the lamp-circuit before the dynamo reaches the potential required to force the normal constant current through the battery to charge it. When the speed of the dynamo rises sufficiently to deliver this smaller current into the battery, the magnet E will attract its core and close the motor-circuit through the contact K^2, wire k^2, and the field-magnet coil g^2, so as to start the motor in a direction to turn the contact-arm M onto the rheostat F. This will serve to increase at the same time the tension of the spring T by the action of the cam L, connected to the arm M upon the lower arm P′ of the angle-lever, whose opposite arm P^2 forms the anchorage for the spring T. As the speed of the dynamo increases the magnet E therefore responds to the gradually-increasing volume of current in the battery branch until the normal current-flow is on and the adjustment of the spring T ceases. Thereafter the magnet E will only permit the prescribed amount of current to flow into the branch and will regulate the system upon the basis of the current

in that branch. The current in the lamp branch, however, will be independent of such regulation, except that the potential applied to the lamps will be determined by the potential necessary to force the prescribed amount of current through the battery. With such a potential applied to the lamps the current in the lamp branch at any time will depend upon the resistance of the lamp-circuit, which of course is determined by the number of lamps which may be turned on, and the lamps may even be turned off entirely without affecting the current-flow in the battery. I arrange, however, that the lamp-circuit shall also contain a certain amount of resistance, which will be cut out when the dynamo is disconnected from the circuit, since the pressure required to force the prescribed current through the battery for charging it would necessarily be somewhat greater than it would be desirable to apply directly to the lamps. To this end I provide two resistances R′ and R^2, which will be inserted in the respective lamp-circuits by the movement of the contact-arm M as it moves toward its on position. Each of these resistances is included in circuit with a corresponding group of lamps, and if there is but one group of lamps then there would be but one resistance. Consequently these resistances will be removed from the lamp-circuit by the reverse movement of the arm M, so that the battery will be free to discharge into the lamps without the intervention of any external resistance after the dynamo is disconnected from the circuit. Since the voltage at the lamps is determined by that required to send the constant current into the battery and is somewhat variable according to the degree to which the battery is charged at any given time, I prefer to add an automatic resistance R^3 in series with the lamps, which will be controlled by a magnet E^4 through the agency of a motor G^2, of which the coil g^3 represents one element and the coil g^4 the other element. The former element is in a circuit shunting the battery *c*, as shown, or it may be in parallel with the lamps. The latter is in a parallel circuit with the lamp, as shown, or may be in a circuit shunting the battery and is closed in one direction or the other by the magnet E^4—that is, the two terminals of the coil g^4 are connected, respectively, to contacts on the respective ends of lever I^2, operated by magnet E^4. The said contacts are brought alternately against the contacts I′ and I^3, which are connected, respectively, to the opposite sides of the lamp-circuit. Thus so long as the pressure on the lamps is of the proper value the circuit of coil g^4 is open; but it will be closed to work the motor in one direction or the other by any departure from such proper value, as such departure is responded to by magnet E^4. The motor will then insert or remove a portion of resistance R^3 until the normal pressure is restored and the motor-circuit again opened. I also provide for adjusting the tension of the spring T^3 of the magnet E^4 by means of the indicator-arm N, which turns on a spindle on which is wound a wire or cord leading from the outer end of the spring. By this means the intensity of all the lamps can be regulated at once. For example, in a sleeping-car the porter can by simply moving the pointer-arm N cause the insertion of more or less of the resistance R^3, and a consequent dimming of the lamps throughout the car without completely extinguishing them.

It will be understood that whenever the train slows up or the switch D is opened the lamps will be operated by the storage battery, which will remain connected to the lamps. As shown in the drawing, the current flowing in that event from the lamps back to the battery will pass through the magnet E and tend to cause it to operate the regulator and perhaps put it in an improper condition for the reconnection of the dynamo or the operation of the lamp from the battery. This may be avoided by connecting the return-line from the battery to the point 8 instead of the point 6, thereby leaving the said magnet out of the circuit from battery to lamps. I prefer, however, to attach to the switch-blade D^2 of the connection-switch D a wedge-shaped extension D^3, which when the blade is retracted to open the switch will enter between the rear end of the magnet-core R and a pin Z, and thereby lock the core against action so long as switch D is open. The said blade D^2 and its extension D^3 are shown in dotted lines. In addition to the lamps B′ and B^2, I also provide certain other lamps B^3 and B^4, which will be automatically lighted as the train comes to a stop and automatically extinguished as the train starts again. These lamps may be placed upon the vestibule of the car or train, so that they may be lighted when such vestibules are used by passengers getting on and off, but will not remain lighted and consume current uselessly when the train is running and they are not needed. The automatic lighting and extinguishing of the lamps B^3 and B^4 is accomplished by means of the switch J, comprising two lamp-circuit terminals and a contact-block K^5, carried by the arm Q^2. Whenever the regulator comes to its zero or off position by the slowing up of the train, the contact K^5 of the switch J is brought into engagement with the two circuit-terminals aforesaid to connect them with the battery, so that the lamps B^3 and B^4 will become lighted. When, however, the train starts again and the regulator moves from its off position, the switch J is again opened and the said lamps will be extinguished.

In other pending applications I have shown and claimed the general method and apparatus herein shown and do not make claim to them in this case. The present application is merely directed toward the particular improvement of regulating for constancy of current in the battery-circuit and variability of current in the lamp-circuit, as hereinafter

claimed, and the further improvement of the automatic lamp-switch, as the same is also claimed.

What I claim is new, and desire to secure by Letters Patent, is—

1. In an electric-lighting system the combination with a variable-speed dynamo of an automatic switch for connecting it to the circuit, electric lamps and storage battery in multiple, and a regulating-magnet for the dynamo included in the branch circuit leading to the battery.

2. In an electric-lighting system the combination with a variable-speed dynamo of an automatic switch for connecting it to the circuit and shunt-magnet controlled by said switch and set to act at a given potential, electric lamps and a storage battery in multiple and regulating devices for the dynamo acting to maintain a constant current in the branch circuit leading to the battery, while permitting the flow of a variable current to the lamps depending upon the lamp resistance.

3. In an electric-lighting system the combination with a variable-speed dynamo of an automatic connection-switch, set to operate at a predetermined pressure, electric lamps and a storage battery in multiple, a regulating resistance in the field-magnet circuit of the dynamo, a motor for operating said resistance and a series magnet included in the branch circuit leading to the storage battery, for controlling the said motor.

4. In an electric-lighting system the combination with a variable-speed dynamo of an automatic connection-switch therefor set to operate at a given potential, electric lamps and a storage battery in multiple, a regulator for the dynamo, a series magnet in the branch circuit leading to the storage battery for controlling the said regulator and means for automatically adjusting the said series magnet to cause it to respond to a greater current.

5. In an electric-lighting system the combination with a variable-speed dynamo of electric lamps and a storage battery in multiple, means for maintaining a constant current in the battery branch circuit and means for maintaining a constant potential on the lamp branch circuit.

6. In an electric-lighting system the combination with a variable-speed dynamo of electric lamps and a storage battery in multiple, a magnet in the battery branch in series with the battery, a regulator controlled thereby, a second magnet in lamp branch in multiple with the lamps and a supplementary regulator controlled thereby.

7. In an electric-lighting system the combination with a variable-speed dynamo of lamps and a storage battery in multiple, a series magnet in the battery branch, a field-magnet rheostat for the dynamo controlled by said magnet, a potential-magnet in the lamp branch and a resistance in series with the lamps controlled by said potential-magnet.

8. In an electric-lighting system the combination with a variable-speed dynamo of an automatic connection-switch, a storage battery, translating devices operated by the battery when the dynamo is disconnected, a regulator and a series magnet in the battery-circuit responding only to current flowing into the battery and controlling the said regulator.

9. In an electric-lighting system the combination with a variable-speed dynamo, of an automatic connection-switch, a storage battery, translating devices operated by the battery when the dynamo is disconnected, a regulating-magnet in series with the battery and a stop for the magnet controlled by the said connection-switch for causing the magnet to respond only to current flowing into the battery.

10. In an electric-lighting system for a railway car or train the combination with a variable-speed dynamo of electric lamps in a branch circuit and a storage battery operated thereby, and a switch in the branch circuit leading to the lamps in series with the lamps controlled by the starting and stopping of the car or train.

11. In an electric-lighting system for a railway car or train, the combination with a variable-speed dynamo of electric lamps and a storage battery operated thereby, a regulator or controller for the dynamo set into operation by the starting of the car or train, a supplementary lamp in a circuit shunting both the dynamo and the battery and an automatic switch for the said supplementary lamps controlled by the said regulator.

12. In an electric train-lighting system, the combination with a dynamo driven by the car-axle, of electric lamps operated thereby, a storage battery for maintaining the lamps when the dynamo is stopped, vestibule-lamps, a controlling-switch therefor and an operating connection between the switch and the car or train for closing said switch as the train comes to a stop and opening it as the train starts.

13. In an electric-lighting system for a railway car or train the combination with a variable-speed dynamo, of electric lamps and a storage battery operated thereby in multiple, an automatic connection-switch for the dynamo, a supplementary lamp-circuit from the battery on the battery side of said connection-switch and mechanism operated by the car-axle to control the supplementary lamp-circuit.

14. In an electric-lighting system for a railway car or train the combination with a variable-speed dynamo, of electric lamps and a storage battery operated thereby in multiple, an automatic connection-switch for the dynamo, a supplementary lamp-circuit, containing a lamp on a car-vestibule and taken from the battery on the battery side of said connection-switch and mechanism operated by the car-axle to control the supplementary lamp-circuit.

15. In an electric-lighting system for a rail-

way car or train, the combination with a variable-speed dynamo of electric lamps and a storage battery operated thereby in multiple, an automatic connection-switch for the dynamo, a supplementary lamp-circuit containing a lamp on a car-vestibule and taken from the battery on the battery side of said connection-switch, a switch in said supplementary circuit in series with the lamp and an operating connection between said switch and the car-axle.

16. In an electric-lighting system the combination with a variable-speed dynamo driven by the vehicle of a magnet in series with the battery and controlling the current delivered thereto, electric lamps in multiple with the battery, a magnet in the lamp-circuit and supplementary regulating devices controlled thereby.

17. In an electric-lighting system the combination with a variable-speed dynamo driven by the vehicle, of electric lamps and a storage battery in multiple, a constant-current regulator for the battery branch and a variable-current regulator for the lamp branch.

In witness whereof I have hereunto set my hand, before two subscribing witnesses, this 14th day of January, 1902.

JAMES F. McELROY.

Witnesses:

ERNEST D. JANSEN,

SAMUEL J. SMITH.