(No Model.) 2 Sheets—Sheet 1.

# J. F. McELROY.

## ELECTRIC CAR LIGHTING SYSTEM.

No. 475,514. Patented May 24, 1892.

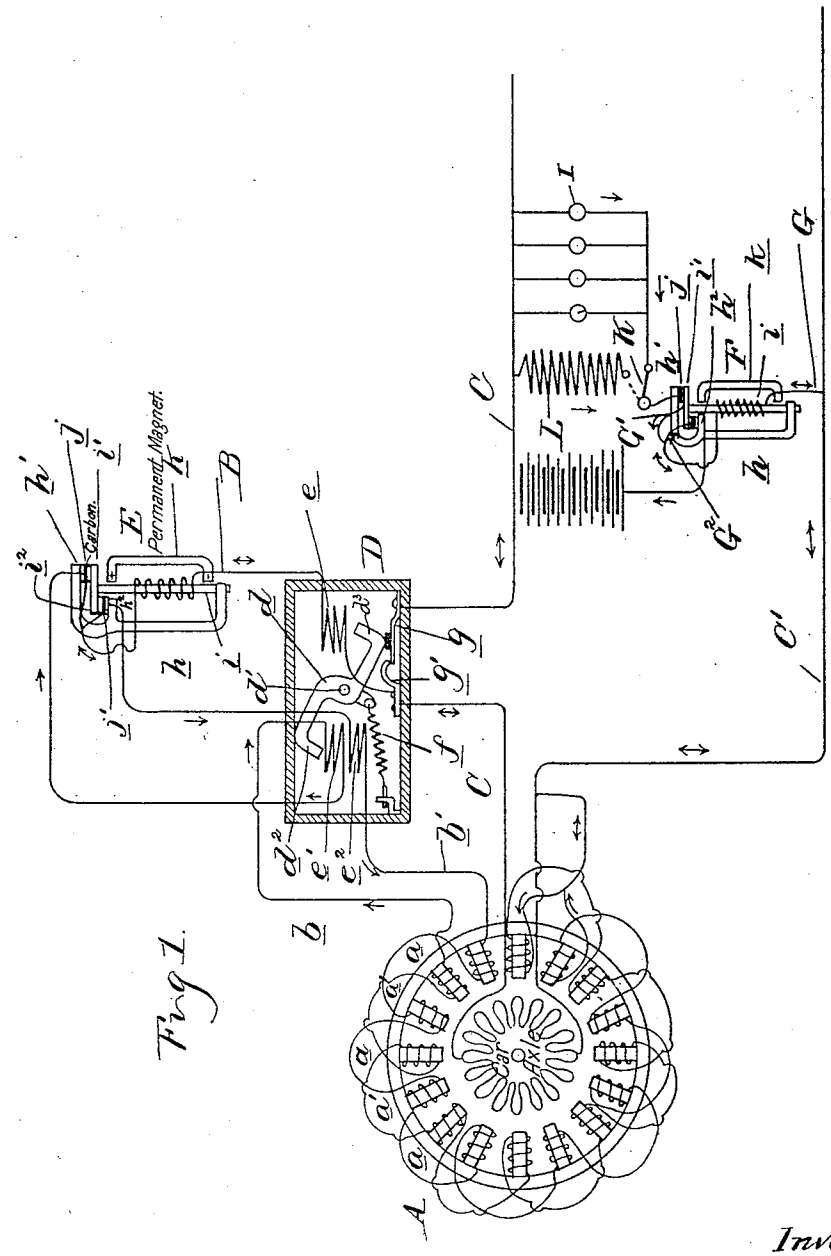


Fig 1.

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(No Model.) 2 Sheets—Sheet 2.

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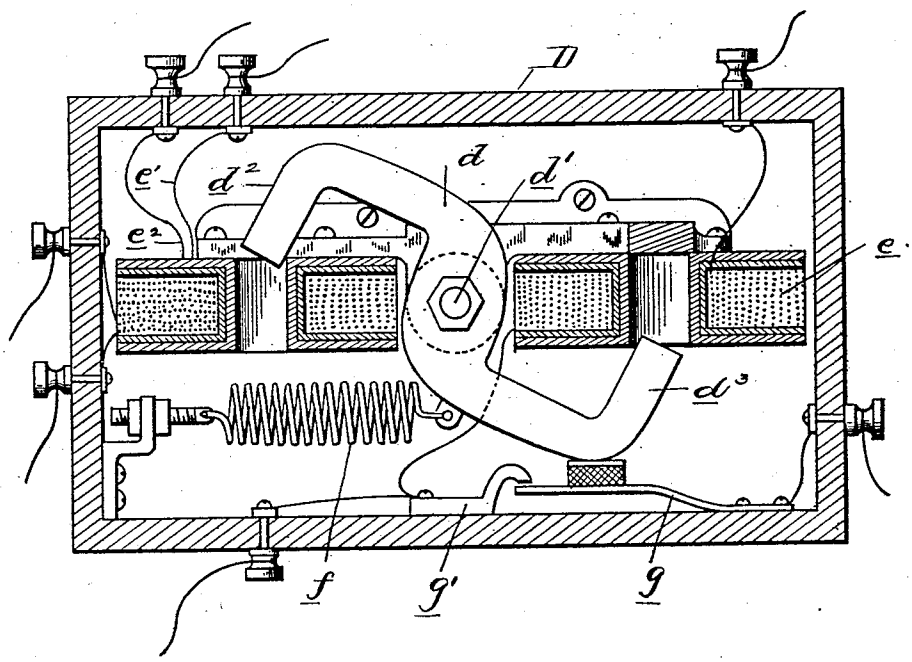
Fig. 2.

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# UNITED STATES PATENT OFFICE.

JAMES F. McELROY, OF ALBANY, NEW YORK, ASSIGNOR TO THE CONSOLIDATED CAR HEATING COMPANY, OF WHEELING, WEST VIRGINIA.

## ELECTRIC CAR-LIGHTING SYSTEM.

SPECIFICATION forming part of Letters Patent No. 475,514, dated May 24, 1892.

Application filed December 19, 1891. Serial No. 415,599. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES F. McELROY, a citizen of the United States, residing at Albany, in the county of Albany and State of New York, have invented certain new and useful Improvements in Systems of Lighting Cars by Electricity, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates to new and useful improvements in systems of electrical distribution for lighting railway-trains by electricity.

The object of my invention is to provide a practical system for lighting cars by electricity; and to this end I have devised a system of distribution the principle of which in general consists in generating the current required for the maintenance of the lights by means of a dynamo operated by the motion of the train itself, and employing in connection therewith a storage-battery of sufficient capacity to maintain the lights during stoppages.

My invention involves a novel system of distribution by which I carry out this principle, and which, briefly described, consists in generating the current by means of an alternating-current dynamo the field of which is maintained by its own current by means of two sets of field-coils included in two branches of a shunt-circuit, through which the current-waves are directed by resistances alternately created in these branches; further, a potential-regulator is employed, which operates by the abnormal increase or decrease of the pressure in the shunt-circuit to decrease the current in the field-magnets, and which when the pressure drops below a certain limit, as in the slacking or stopping of a train, opens the main circuit of the dynamo. Each car is equipped with the requisite number of lamps and with a storage-battery, the lights being placed in multiple between one of the main leads and one of two branches of a feeder from the other main lead and the storage-battery being placed in circuit with the same main lead and the other branch of the feeder, with a current-director placed in the feeder, whereby one phase of the current is directed through the lamps and the other through the storage-battery. The storage-battery is adapted to maintain the lamps only during the time required for stoppages of the train. One storage-battery, however, may be used for all the cars instead of placing one in each car.

The object of my arrangement is to employ devices and instrumentalities which are not liable to get out of order and which operate automatically. To this end I have dispensed with the use of a dynamo requiring a commutator, as this is a constant source of trouble, requiring close attention, which it could not be given in the running of trains. The same holds good for all other devices employed for distributing and regulating the current and in which there are moving contacts, which occasion sparking and present a constant source of annoyance and trouble. My devices constantly operate in closed circuits without any making or breaking of contacts while in operation. The resistances which I use are merely in the nature of obstructions, which simply divert the current from one path to another or prevent its passage, more or less, as in the case of the potential-regulator.

Having now described my invention in general, I will describe it more in detail in connection with the accompanying drawings.

Figure 1 is a diagrammatic representation of my system of train-lighting; Fig. 2, an enlarged detail of the current-regulator.

A represents the alternating-current dynamo, which is intended to be operated by the motion of the train in any known manner, preferably by securing the armature upon one of the axles of the forward truck of the locomotive with the field secured to the frame of the truck. This field has two alternate sets of field-magnets $a\,a'$, each included in a separate branch of a shunt-circuit B, which is connected to the main leads C C′ on the locomotive or car itself, on which the dynamo is placed, and this shunt-circuit always remains closed.

D is the potential-regulator, preferably placed in the car under the eye of the engineer on the locomotive. It consists of a bar of iron $d$, turning upon a pivot $d'$, and with its ends bent to form suitable cores $d^2\,d^3$, adapted

to enter into the wire helices $e$ $e'$ $e^2$, placed in proximity thereto. The helix $e$ is included in the shunt-circuit B and the helices $e'$ $e^2$ are respectively included in the two branches $b$ $b'$ of the shunt-circuit. The two helices $e'$ $e^2$ form one compound coil, although for the sake of clearness they are shown as two separate coils. They are also wound in opposite directions. A potential-spring $f$ is secured to the bar $d$ to normally withdraw by its tension the cores $d^2$ $d^3$ from the helices, and contacts $g$ $g'$ are arranged whereby one end of the bar is adapted to operate against the spring $g$ of said contact to make and break connection with the fixed contact $g'$. The contacts $g$ $g'$ constitute a make-and-break connection in the main lead C of the generator, and the force of the spring is adapted to break said contact by pressing the end of the bar $d$ against the spring $g'$.

E is a current-director consisting of the rigid frame $h$, provided near one end with two abutments $h'$ $h^2$. To the other end of this frame is secured one end of the core of an electro-magnet $i$, while the other end of said core is free and has two abutments $i'$ $i^2$ formed thereon, which are correspondingly opposite and between the abutments $h'$ $h^2$ on the frame. Carbon disks $j$ $j'$ are interposed between these abutments on opposite sides of the abutments on the magnet-core, whereby the latter in expanding or contracting its length is adapted to compress or clamp one of the pile of carbon disks, more or less. The core is comparatively long. Its coil is included in the shunt-circuit B, and alongside the electro-magnet $i$ is secured a permanent magnet $k$, extending with its pole in proximity to the poles of said magnet. The shunt B after passing through the coil of the electro-magnet $i$ divides into the two branches $b$ $b'$, which are connected, respectively, to the carbon disks $j$ $j'$ and from there lead to the field-magnets, to which they are alternately connected in any desired manner. The main leads C C' extend from the locomotive to the cars to be lighted, and are provided with the usual coupling devices for connecting and disconnecting them between the cars.

F is another current-director located on a car. It is preferably of the same description or type as the current-director E, just described, and its electro-magnet is included in a feeder G from the main lead C'. After passing through the electro-magnet the feeder divides in two branches G' G², one connecting through one of the pile of carbon disks of the current-director and extending from there to form a feeder for the lamps, and the other connecting through the other pile of carbon disks and extending from there to form a feeder for the storage-battery. The lights I are in multiple between the main lead C and the branch feeders G' G², respectively.

K is a switch in the branch feeder G², and L is a fixed resistance equal to the resistance of the storage-battery, all so arranged that the branch feeder G² may be connected either to the resistance or to the lamps.

In practice the parts being substantially arranged and constructed as shown and described, they are intended to operate as follows: When the locomotive is at rest, the dynamo-circuit is held open by the vibrating armature of the potential-regulator in pressing down upon the spring-contact $g$. When the train starts up, the dynamo will at once begin to generate a current, which is all sent into the field-magnets through the permanently-closed shunt, the current-waves of one direction flowing through one set and the current-waves of opposite direction flowing through the other set of field-magnets. This is brought about by the current-director, the electro-magnet of which is energized by the current flowing through its coil, thereby producing a lengthening of the core due to the magnetizing effect. However, as the current is alternately in opposite directions it will alternately reverse the polarity of the core, and therefore if the polarity is such as to satisfy the polarity of the permanet magnet $k$ its magnetism will be greatly increased and its core correspondingly increased in length, while if the magnetism of the core is counteracted by the permanent magnet the core will be shortened. Thus one current-wave may be made to produce a tight clamping or compressing upon the pile of carbon disks $j$ and the opposite current-wave produce a similar effect upon the pile of carbon $j'$. The conductivity through one pile of carbon disks is thus increased, while the one of the other pile of carbon is simultaneously decreased. The current-director is arranged to operate in this manner and has suitable adjusting devices to produce the desired compression alternately upon the two piles of carbon disks, thus affording the current impulses of one director an easier passage through one branch and to the current impulses of the opposite direction an easier passage through the other branch without at any time producing a break in the circuit. The dynamo is thus made self-exciting, and as the current will rapidly increase with the speed of the train it will soon produce sufficient pressure to rock the armature $d$, owing to the magnetizing effects of the helices $e'$ $e^2$ upon the cord $d^2$. A slight rocking of the armature $d$ is sufficient to allow the spring-contact $g$ to close the circuit of the dynamo to the cars, and thereby supply the lights with the necessary current and at the same time charge the storage-battery for future use, the operation of the current-director F being such as to direct the current impulses in one direction through the lights and those in the opposite direction to the storage-battery until the latter is fully charged. The storage-battery, it will be seen, is always connected to the lamps when the switch K is closed, and thus upon any failure or irregularity of the current the lamps are fed by the storage-battery, and the latter will

thus tend to maintain the lights uniform. Should it be desired to charge the storage-battery without burning the lamps, the switch K is turned to close with the resistance L, which allows, again, one-half of the current to be passed into the storage-battery. Whenever the pressure of the dynamo-current drops below the normal degree as adjusted by the spring *f* from any cause whatever—such as by a decrease in the speed of the train or by the battery-current overcoming the dynamo-current when the battery is fully charged—the potential-regulator will automatically disconnect the dynamo from the storage-battery and lamps, and the latter will be taken care of by the storage-battery until the current again comes up.

The regulation of the current is extremely simple and is especially valuable in a system of train-lighting where the relatively slow step-by-step movement of the variable resistance-regulators is entirely inadmissible, letting alone the matter of contacts which would lead to sparking and consequent fusing or burning out or other danger.

By looking at the drawings it will be seen that in my current-regulator the magnetic cores are entirely withdrawn from the helices and the latter offer but a slightly-appreciable resistance to the passage of the current. Even after the armature has left the contact-spring *g* the cores are still outside the helices. Upon an increase of current above the normal pressure the magnetizing effect of the helices $e'$ $e^2$ upon the core $d^2$ will increase the immersion of the cores into the helices and the coil *e* becomes essentially a choke-coil, and the more the pressure increases the more the cores $d^2$ $d^3$ will be drawn within the helices against the increasing tension of the spring *f*, and thereby choke the current supplying the field. The choking effect of a piece of iron being thrust within a helix traversed by an alternating or intermittent current is very great, much greater than the mere presence of the iron alone would make it, and as the range of the effect is from a mere proximity to entire immersion of both cores within the helix the cumulative effect of choking the current operates within widely-separated limits.

Instead of arranging the field-magnets in two sets, as shown, each field-magnet may be provided with two coils included in the two branches of the shunt, and I claim this arrangement as an obvious modification.

I have designed for practical use a current-director and a regulator embodying the principle of operation herein described and shown, but which are of superior mechanical construction and which are described and shown by me in separate applications for Letters Patent.

What I claim as my invention is—

1. In an electric system of lighting cars, the combination of a generator of alternating currents provided with two sets of field-coils, two main leads extending through the cars, a shunt-circuit divided into two branches connected to alternate field-coils, and a current-director operated by the passage of the current through said shunt-circuit to divert the current-waves of one direction to one branch of said shunt-circuit and those of the opposite direction to the other branch of said circuit, substantially as described.

2. In an electric system of lighting cars, the combination of a generator of alternating currents provided with two sets of field-coils, two main leads extending through the cars, a shunt-circuit divided into two branches, one for each set of field-coils, a current-director operated by the passage of the current through said shunt-circuit to divert the current impulses of one direction to one branch and those of the opposite direction to the other branch of said shunt-circuit, and current-regulating devices comprising a choke-coil in the shunt-circuit, whose iron core is immersed or withdrawn from the coil by the operation of a controlling-magnet in the branches of the shunt-circuit, substantially as described.

3. In an electric-light equipment for cars, the combination of two main conductors, means for supplying the same with an alternating current, a storage-battery and lamps respectively in circuit with one of the main conductors and with separate branches of a feeder from the other main conductor, and a current-director in said feeder operated by the current passing through said feeder to divert the current impulses of like direction alternately to one and the other branch of said feeder, substantially as described.

4. In an electric-light equipment for a car, the combination of two main conductors forming part of the main leads of an alternating-current generator, a storage-battery and lamps respectively in circuit with one of the main conductors and with separate branches on a feeder from the other main conductor, a current-director in the feeder, operated by the current passing through said feeder to divert the current impulses alternately over one or the other branch of the feeder, a resistance in a shunt-circuit with the lamps, and a switch in the lamp-circuit for cutting out the lamps and closing the circuit through the resistance, substantially as described.

5. In an electric-light equipment for a car, the combination of two main conductors of an alternating-current generator, a storage-battery in circuit with one of said main conductors and with one branch of a feeder from the other main conductor, lamps in multiple with the same main conductor and with another branch of said feeder, carbon disks or like bodies having their conductivity increased or decreased by an increase or decrease in pressure included in each branch of said feeder, and a magnetic device operated by the current impulses passing in opposite directions through the feeder to alternately

compress the carbon disks in the branches thereof, substantially as described.

6. In an electric system of lighting cars, the combination, with a supply-circuit including translating devices in two separate branches thereof, of two piles of carbon disks, one in each branch of said circuit, an electro-magnet in said circuit, arranged to compress with its core one or the other of said piles of carbon disks by a contraction or expansion in its length, respectively, and a permanent magnet extending with its poles in proximity to the poles of the electro-magnet, whereby upon the passage of an alternating current through said circuit the core of said electro-magnet is alternately lengthened and shortened, and thereby correspondingly compresses one or the other pile of carbon disks to divert the current impulses of one direction to one branch and those of the opposite direction to the other branch, substantially as described.

7. In an electric system of lighting cars, comprising a generator of alternating currents, provided with two sets of field-coils, two main leads extending through the cars, a shunt-circuit divided in two branches, one for each of the field-coils, and a current-director in said shunt-circuit, a combined regulator and switch consisting of a choke-coil in the shunt-circuit, a controlling-magnet formed of two oppositely-wound helices included, respectively, in the two branches of the shunt-circuit, a tilting bar carrying wires for the choke-coils and controlling-magnet, respectively, a spring for retracting the same, and a switch for cutting out the main leads, operated by said tilting bar in its retracted position, substantially as described.

8. In an electric system of lighting cars, the combination of a generator of alternating currents, provided with two sets of field-coils placed on the locomotive, two main leads extending through the cars, a shunt-circuit divided into two branches connected to alternate field-coils, a current-director in said shunt-circuit, storage-batteries and lamps placed in each car and included, respectively, in circuit between one of the main leads and separate branches of a feeder from the other main lead, a current-director in said feeder, operated by the current passing through the same to divert the current impulses of like direction alternately to one and the other branches of said feeder, substantially as described.

In testimony whereof I affix my signature in presence of two witnesses.

JAMES F. McELROY.

Witnesses:
EDWIN A. SMITH,
HOMER J. NODINE.