(No Model.)

J. H. MARSHALL.

SYSTEM OF LIGHTING CARS BY ELECTRICITY.

No. 353,797. Patented Dec. 7, 1886.

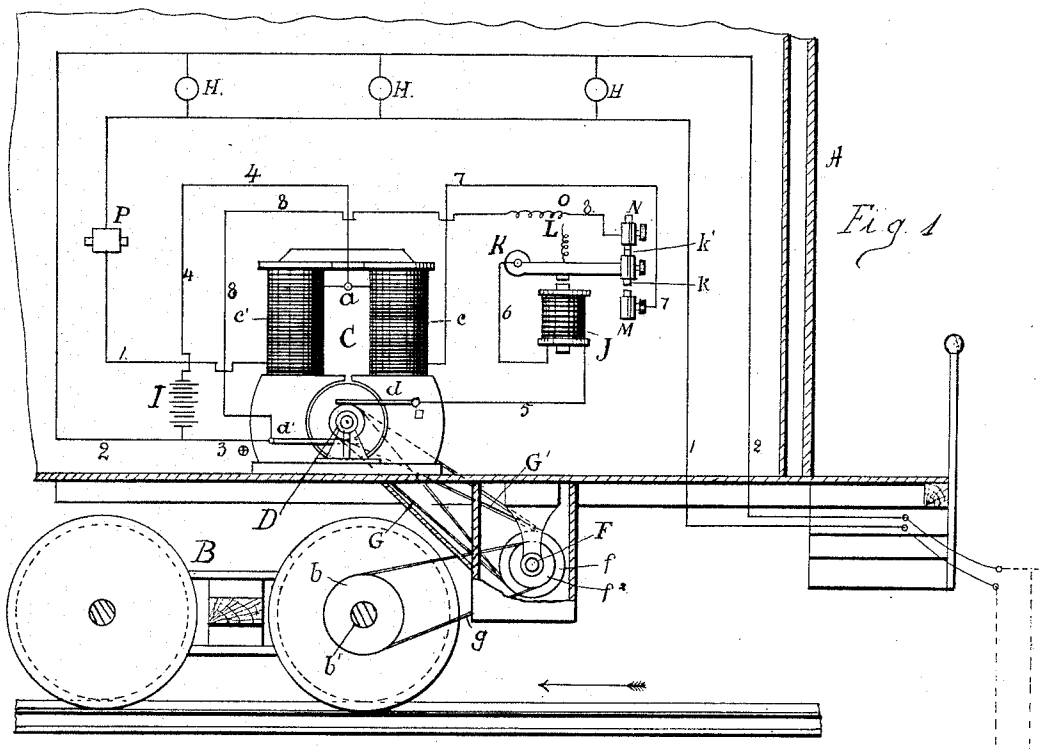


Fig. 1

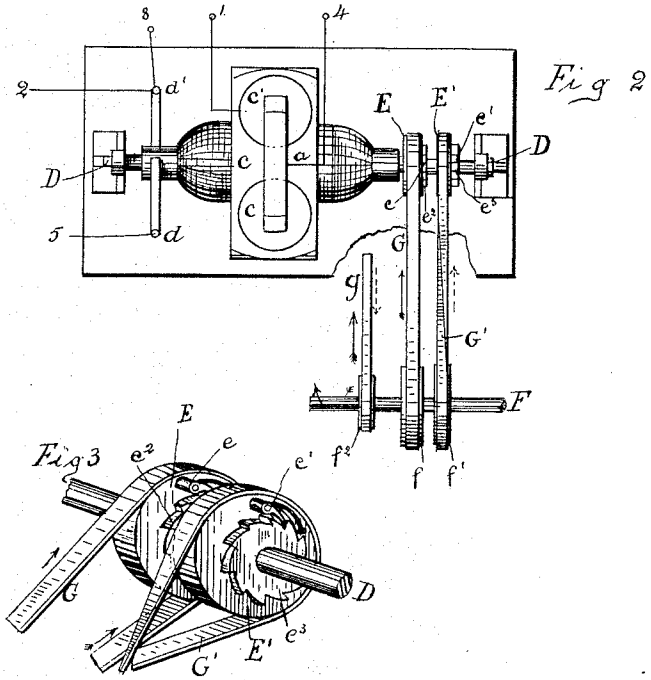
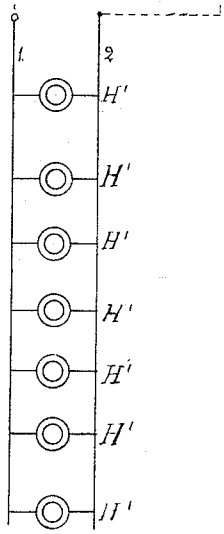


Fig 2

Fig 3



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SYSTEM OF LIGHTING CARS BY ELECTRICITY.

SPECIFICATION forming part of Letters Patent No. 353,797, dated December 7, 1886.

Application filed April 13, 1885. Serial No. 162,158. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH H. MARSHALL, a citizen of the United States, and residing at Grand Rapids, in the county of Kent and State of Michigan, have invented certain new and useful Improvements in Systems of Lighting Cars by Electricity, which are fully set forth in the following specification, reference being had to the accompanying drawings, in which—

Figure 1 represents a portion of the car and a diagram illustrating the application of my improvements; Fig. 2, a detail plan of the dynamo and the devices for operating it, and Fig. 3 a detail perspective, on an enlarged scale, of the double clutch-driving pulley on the dynamo-shaft.

The object of my invention is to provide for the application of electric lights to moving cars.

It is obvious that in any attempt to apply the ordinary system of electric lighting to moving cars very serious obstacles will be encountered. The dynamo is almost universally used for the purpose of supplying current to a system of stationary lights; but when this machine is applied to a train of cars, if it is run by any of the moving parts of the train, it must stop and start with the latter, and so the supply of current be subjected to constant interruption, which will be fatal to the practical use of the lights. To meet this difficulty the dynamo may be run by a supplementary engine supplied with steam directly from the boiler of the locomotive on steam-railways, so that the stopping of the train will not interfere with the running of the dynamo; but this plan involves additional expense and necessitates the mounting of a dynamo-machine upon nearly every engine, together with the supplementary machinery for driving it. The application of electric lights to trains of cars has also been attempted with secondary or storage batteries to supply the current. This plan of course overcomes some of the difficulties mentioned above which attend the use of the dynamo; but it also is objectionable for general use. It must be obvious that the practical application of the storage-battery system is very limited, for the accumulation of a store of electricity sufficient to supply a series of lights on a long train of cars for any considerable distance is practically impossible within reasonable limits of space. In addition to this difficulty there is the expense of charging the batteries. My invention is intended to overcome all of these difficulties and to provide a practical method for supplying a dynamo-system of lights to moving cars. This I accomplish by applying the dynamo to the cars in such way that it is driven by one of the axles, or some other moving part, and by employing in connection therewith a secondary or storage battery to maintain the lights during stoppages. This is the principle of my invention, speaking in general terms; but in carrying out the invention in a practical way the storage-battery is connected with the dynamo, so as to be fed thereby, and therefore my improvement includes automatic means for switching the dynamo in when the speed thereof is sufficient to generate electro-motive force enough to prevent the storage-battery from causing a reversal, and switching out the dynamo when it is not sufficient. It also contemplates means for preserving a standard amount of magnetism in the field-magnets of the dynamo, so that the latter will be operative at once upon starting to supply current to the light-circuit. It also contemplates means for automatically regulating the generator or dynamo, so as to maintain a uniform candle-power of light, notwithstanding variations in the speed of the moving cars.

Having mentioned in a general way the several prominent features of my invention, I will now proceed to describe in detail one way in which I embody my invention in a practical manner, and will then point out definitely in the claims the special improvements which I believe to be new and wish to protect by Letters Patent.

In the drawings, A represents a portion of a railway-car, the side of which is removed to expose the interior to view, and B one of the trucks of the car. A dynamo is mounted in this car. It may be of any construction in its general features, and as the main parts of a dynamo are well known I shall only designate them here for the purpose of clearness of reference hereinafter.

C is the field-magnet, the two coils *c c'* of which are wound as usual.

D is the armature-shaft, on which is mounted the armature, and *d* is the positive brush and *d'* the negative.

The means shown in the drawings for driving the dynamo are as follows: Two wheels or pulleys, E E', are mounted loosely on the armature-shaft side by side, and are provided with spring-pawls *e e'*, which are arranged to engage with ratchet collars e^2 e^3, placed alongside of the pulleys, the pulleys and ratchets being identical in arrangement, so as to engage in the same direction, thus providing for the driving of the armature-shaft in one direction only by either of these pulleys or wheels.

Underneath the car is a counter-shaft, F, mounted in suitable bearings, and preferably inclosed, this shaft being parallel with the armature shaft, which is also parallel with the axles of the truck-wheels. On the counter-shaft are two pulleys or wheels, *f f'*, which are identical and correspond in arrangement respectively with the ratchet-wheels *e e'*. An open belt, G, runs from the counter-shaft pulley *f* to the clutch-pulley E, and a cross-belt, G', from the pulley *f'* to the clutch-pulley E', as shown in Fig. 2 of the drawings. On the counter-shaft is also another pulley, f^2, over which a band, *g*, runs to a suitable driving-pulley, *b*, on one of the axles *b'* of the car-truck. It is evident that by this mechanism the revolution of the truck-axle will rotate the counter-shaft, which in turn will revolve the armature-shaft of the dynamo; and it will also be seen that in whichever direction the truck-axle revolves the armature shaft will always be turned in one and the same direction, this result being obtained by using a double set of driving-pulleys on the armature and counter-shafts, one of which is provided with an open belt and the other with a cross-belt. It will be seen, then, that one of the clutch-pulleys will always be turned in an operative direction, while at the same time the other will be turned in an inoperative direction, their relations changing in this respect as the direction of the car is changed. Sprocket chains and wheels may be used for this driving mechanism instead of plain belts, if desired, and perhaps may be preferable, as the required motion will then be more positive and certain.

The conductors 1 2 constitute the main circuit leading from the dynamo-machine, and the lamps H are arranged in multiple with these main conductors. Obviously, then, whenever the car is in motion the dynamo will also be kept in motion, thereby sending out a current over the main line and through the lamps in the usual way.

In order to keep up the current when the car stops, and of course the dynamo rests, I provide a storage or secondary battery, I, conveniently arranged within the car and also in multiple with the main circuit by means of the conductors 3 4, the former of which connects with the negative main conductor and the latter with the field-coils of the dynamo, a convenient means being a binding-post, *a*, to which this conductor is connected, and which is connected up with the field-magnet coils, as shown in Fig. 1 of the drawings. Now, when the car stops, the current flows back from this storage-battery through the conductor 4 and one of the coils, *c'*, on through the main conductor 1 and the lamps to the negative conductor 2, back to the storage-battery or generator, thus supplying the necessary current to keep up the light while the dynamo is at rest during the stoppage of the train. It is not necessary to the working of the storage-battery for supplying current during stoppages that it be put in connection with the field of the dynamo. It is obvious that, so far as this function merely is concerned, the storage-battery might be connected in any way which would bring it into circuit with the lamp-circuit when the dynamo is at rest. The connection of the storage-battery with the field is to give the former an additional function, which is very important in the practical operation of these devices, and therefore this arrangement is preferred by me. It will be seen that under this arrangement the field-magnet will be kept charged by the operation of the storage-battery, the current from which flows to the field-coil before passing out to the main conductor. The result is that the dynamo is effective immediately upon starting up again, to supply current to the lamps, the usual waiting for priming the field being obviated, as the field-magnets are already charged. The storage-battery being connected up in multiple with the main circuit, as already stated above, the dynamo not only provides current for the lamps, but also charges this secondary battery while running, so that while the train of cars is in motion, not only is the dynamo run to keep up the lights, but also to store up current for use when the train stops, and therefore the secondary battery may be of comparatively small dimensions.

It will be seen from the above description that there may be danger of the reversal of the generator, caused by the secondary battery backing through it. To prevent this I provide an automatic switch or cut out in the main circuit, arranged preferably between the positive brush and the field-magnet coils, which opens the circuit when the car is stopped, thereby forcing the current from the secondary battery through the conductors, as described above; but which closes the circuit when the generator is started again by the starting of the car, thereby sending the current, as usual, through the field-coils in its regular circuit and putting the storage-battery in multiple with the lamps, so as to feed the storage-battery while the generator is in motion. I have devised a specially-constructed automatic switch or cut-out adapted for this purpose, which I will now proceed to describe. An electro-magnet, J, wound as usual, is connected by a conductor, 5, with the positive brush, and by another conductor, 6, with a switch-lever, K, which in this instance is piv-

oted at one end and is arranged as an armature to the magnet J. A retractile spring, L, is attached to this lever, which operates to pull it away from the magnet, and at the outer end of the lever are contacts *k* and *k'* arranged on opposite sides thereof. A contact, M, is connected by a conductor, 7, with the field-magnet of the generator, being shown in the drawings connected with the coil *c* thereof, and on the other side of the switch-lever is a similar contact, N, which is connected by a conductor, 8, with the negative brush or the negative conductor in the main circuit. Now, when the generator is in operation, it is obvious that the magnet J will become charged, and when its force is sufficient to overcome the retractile spring the switch-lever will be drawn up to the magnet, thereby making contact with M, and, commencing with the positive brush, the circuit will be through the conductor 5, magnet J, conductor 6, switch-lever K, contact M, and conductor 7 to the field-coil, and thence out over the main circuit to the lamps and storage-battery, when, of course, the generator will run the lamps and charge the storage-battery, as already described. When the car slows up or stops, the current from the generator is of course diminished or stopped altogether, and the magnetic power of the electro-magnet J decreases until a point is reached where its force is less than that of the tractile spring, and so the latter will operate to draw away the switch-lever from the magnet, opening the circuit between the contacts M and *k*, and making contact between N and *k'*, thereby opening the generator-circuit but closing the armature-circuit around through the conductor 8 to the negative brush, thus cutting out the generator-circuit and effectually preventing the secondary battery from backing through the generator and causing a reversal, for it will be seen that in this condition there will be no cross-circuit between the switch and generator connections. As soon as the car starts and the generator commences to run again the electro-magnet J will at once be charged from the conductor 5, with the operation and results first described.

In the conductor 8 is placed a resistance, which may be a resistance-coil, O, or any other device in use for this purpose, and this resistance is of certain determined quantity, so that when the armature-circuit is closed the switch cannot be operated until the dynamo has generated enough current to prevent the storage-battery from backing through it; and the purpose of closing the armature-circuit through the resistance, as described above, when the generator is not in action, is to weigh the amount of current that must be generated before it is switched into circuit with the secondary again; or, in other words, the dynamo in starting must always generate enough current to resist backing up from the storage-battery before the switch will operate. It is evident, also, that the retractile spring L must be of sufficient strength to hold the switch-lever out of contact with the magnet, even though the latter may be affected somewhat by current from the storage while the car is at rest. I also arrange in the conductor 1 an automatic current-regulator, P, which may be of any suitable construction, and as such regulators are well known I give no special description here. The location only of the regulator is important. It should be in such part of the main circuit that the current passing through it will be that which passes through the lamps. A uniform current is thus provided for the lamps which will therefore afford a uniform light. The varying quantity of current necessary to charge the storage-battery, in addition to running the lamps, must not affect the regulator, and the arrangement of the latter in the conductor 1 effects this result. The regulator does, however, prevent variations caused by the varying speed of the cars.

I have described above one way in which my invention may be completely carried out in practice; but I do not wish to be understood as limiting myself in all particulars to the construction and arrangement of devices herein set forth and shown. There may be changes and modifications in details without departing from the characteristic features of the invention; and I may mention here that the method I have described and illustrated for maintaining a standard amount of magnetism in the field may be accomplished in some other way, and other means will be suggested to those familiar with the art.

I do not wish to be understood either as limiting myself to the particular switch or cut-out here shown and described, as any known construction of this device adapted to secure the operation desired will serve the purpose. I have simply illustrated and described a cut-out which I have devised, and which is especially adapted to this particular application, and which, therefore, is preferred by me. The location of the generator is also a matter of convenience. It may be placed in any car or on any part of a moving train, and the mechanism for driving it is not necessarily limited to the devices I have herein set forth.

It will be understood, of course, that the main conductor may be extended from the generator-car to other cars, as I have illustrated by diagram in Fig. 1 of the drawings, in which H' H', &c., represent a series of lamps in other cars.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. In a system of electric lighting for cars, a dynamo or generator, in combination with a group of lamps and a storage-battery, all in multiple with the dynamo, and a cut-out in the main or dynamo circuit, substantially as and for the purposes set forth.

2. In a system of electric lighting, a dynamo or generator, in combination with a group of

lamps and a storage-battery, all in multiple with the dynamo, and the storage-battery in circuit on one side with the field-magnets thereof, and a cut-out in the main or dynamo circuit, substantially as and for the purposes set forth.

3. In a system of electric lighting for moving cars, a dynamo or generator, in combination with a group of lamps and a storage-battery, all in multiple with the dynamo. and the storage-battery in circuit on one side with the field-magnets, and an automatic electric cut-out, substantially as and for the purposes set forth.

4. In a system of electric lighting for moving cars, a dynamo or generator, in combination with a group of lamps and a storage-battery, all in multiple with the dynamo, and the storage-battery in circuit on one side with the field-magnets, an automatic electric cut-out or switch, and a resistance coil in the armature-circuit of the switch, substantially as and for the purposes set forth.

5. The band-wheel *b* on one of the truck-axles, in combination with the counter-shaft F, band *g*, clutch-wheels E′ E′ on the driving-shaft of the dynamo, the open band G, and cross-band G′, substantially as and for the purposes set forth.

6. The dynamo, in combination with a group of lamps arranged in multiple, the secondary battery I, the conductors 3 4, and the field-magnet coils *c c′*, substantially as and for the purposes set forth.

7. The dynamo, in combination with the secondary battery I, the electro-magnet J, conductors 5 6, switch-lever K, contacts M N, and the conductors 7 8, substantially as and for the purposes set forth.

8. The dynamo, in combination with a group of lamps and the storage-battery, all in multiple with the dynamo, the electro-magnet J, conductors 5 6, switch K, spring L, contacts M N, and conductors 7 8, substantially as and for the purposes set forth.

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