(No Model.)

C. J. VAN DEPOELE.

ELECTRIC RAILWAY TRAIN SYSTEM.

No. 434,686. Patented Aug. 19, 1890.

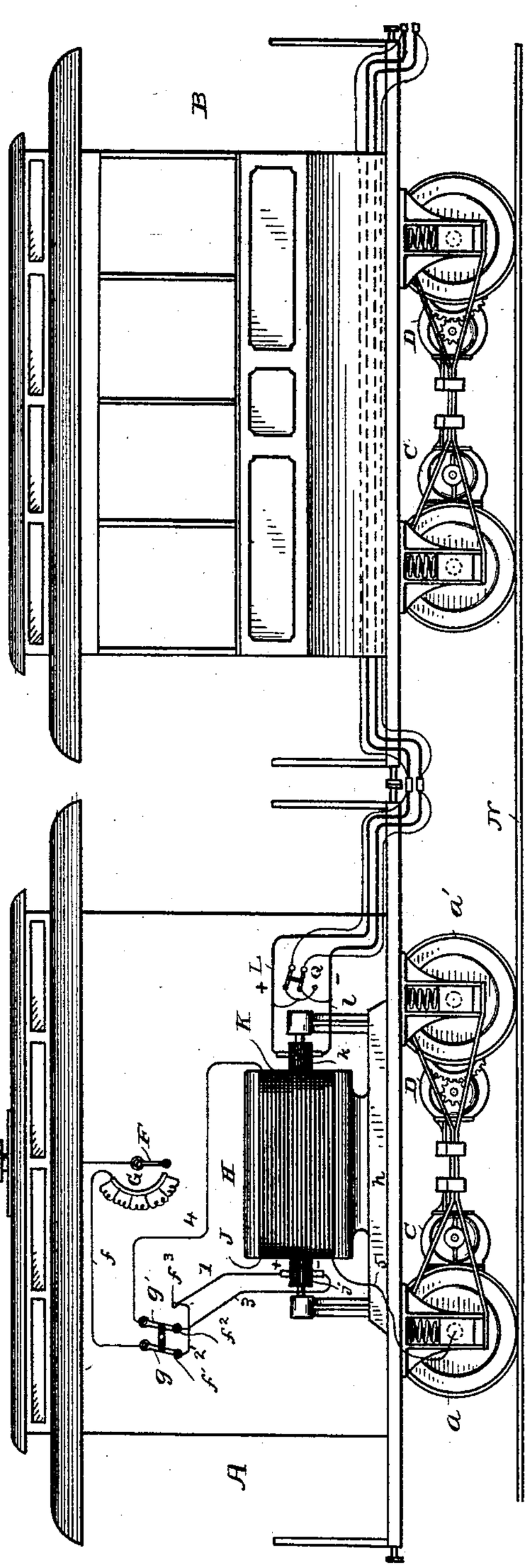

Fig. 1.

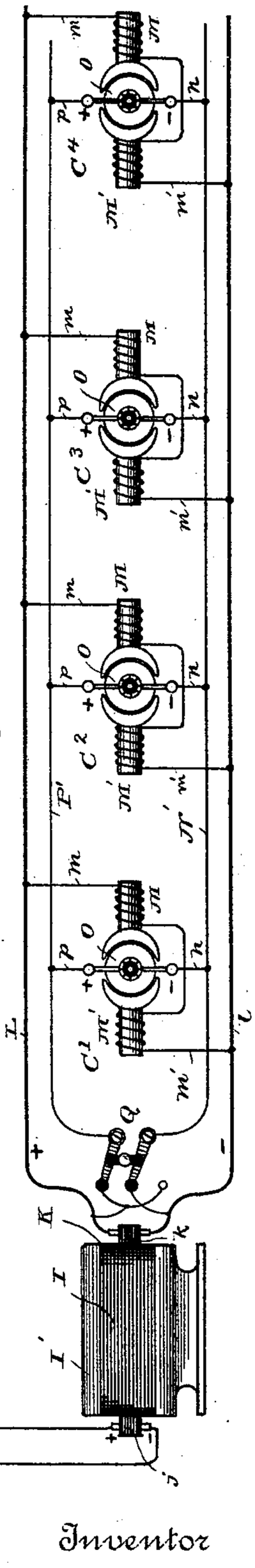

Fig. 2.

Witnesses

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ELECTRIC-RAILWAY-TRAIN SYSTEM.

SPECIFICATION forming part of Letters Patent No. 434,686, dated August 19, 1890.

Application filed August 21, 1889. Serial No. 321,541. (No model.)

To all whom it may concern:

Be it known that I, CHARLES J. VAN DEPOELE, a citizen of the United States, residing at Lynn, in the county of Essex and State of Massachusetts, have invented certain new and useful Improvements in Electric-Railway-Train Systems, of which the following is a description, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon.

My invention relates to improvements in electric railways; and it comprises an entirely novel plan of distributing the current to be employed in operating the propelling-motors upon the cars thereof. In the present instance the current is of the continuous type, although the principle applies to currents of all classes, for some of the specific applications of which I have filed separate applications for Letters Patent. The plan involves means for regulating and controlling the speed and power of all the motors upon an entire train without the use of current-consuming resistances for each separate motor, the regulation affecting either the intensity or the electro-motive force of the current supplied to all the motors upon a train.

The principal features of the invention comprise supply-conductors extending along the line of the railway from a source of current, and the supply or primary current is collected by suitable traveling contact devices moving with the motor car or cars and led to a current-transformer upon the motor-car, which device serves to control the electro-motive force or the intensity of the secondary current, and to supply the same to a local circuit or circuits moving with the vehicles, in which said circuits the propelling-motors are connected, and all affected by the character of the current in the local or train circuit. Where a line of railway is of great length it may be essential to commercial efficiency that the supply-current be transmitted as of a relatively-high potential—say of one thousand volts—in which event the converter upon the motor-car is arranged to reduce the potential to, say, two hundred volts (more or less) before the same is transmitted to the local or train circuit, from which the propelling-motors are supplied. Obviously, however, the function of controlling the electro-motive force of the said current remains, whether or not the potential be reduced by the converter. So completely is the current in the local circuit controlled by the converter that the electro-motive force of the current in the train-circuit can be regulated as desired, or in case of series distribution the current instead of the electro-motive force can be varied at will. With continuous currents it will be necessary to use some form of machine, known generically as a "motor-generator." It will readily be perceived that by controlling the current supplied to the motor-generator the output of the generative portion thereof, whether as to electro-motive force or to intensity of current, will be entirely under control, and therefore that instead of interposing wasteful resistance in the path of the supply-current between the main conductors and the local circuits of the motor, as is the common practice, by controlling the speed of the motor-armature of the motor-generator the desired results are attained, and the current for all the motors of the train-circuit thereby regulated from a single point. Where a single motor-car or locomotive of sufficient capacity and weight is used to propel the train an extra heavy structure or extra heavy bridges, &c., are necessary in order to carry the weight of the locomotive. Where, however, no one car in the train weighs much if any more than the others, if each car is provided with propelling mechanism it will be apparent that trains may be extended to any length without requiring changes in or increased strength of bridges, &c.

A paramount objection to the employment of a number of separated motors upon a train has been the extreme difficulty of giving to each motor the proper attention. By my present invention, however, any desired number of cars provided with electric motors may be connected together and operated as a train. It will further be understood that the train need not necessarily be composed entirely of motor-cars, as ordinary passenger-cars may be sandwiched in between the motor-cars according to the power of the said motors, the grades to be surmounted, and the speed desired. Each car of the train is provided with conductors and couplings at the extremities thereof whereby all the motors of the train

may be coupled together to form a local circuit traveling therewith.

In order to transmit current from the generating-station along a line of railway many miles in length with economy, I employ a circuit of conductors which may be either suspended or underground, and over this circuit of supply-conductors the current can be sent at a relatively high potential—that is to say, a potential sufficient to overcome the resistance of long lengths of conductor without material loss. I prefer, however, that the current for operating the motors should be of relatively low potential, so low, in fact, as to entirely eliminate all danger to persons or animals even should they short-circuit any of the train-conductors. I accomplish these results by utilizing the supply-current to drive the armature of a motor-generator or equivalent device, which should be placed in the front or principal motor-car provided for that particular purpose.

The generating-armature of the motor-generator will supply current to the local or train circuit, including all the motors to be driven, and the supply of current can be controlled with the utmost facility by an adjustable rheostatic field-magnet coil, as set forth in my patent, No. 347,902, dated August 24, 1886, or similar means in the primary circuit of the motor-generator. The train-circuit is provided with suitable means for reversing the direction of rotation of all the motors included therein, and the entire system of motors is as completely under the control of the operator at the motor-generator as though each motor were in charge of a separate person. The motor-generator being arranged and adapted to vary the electro-motive force of the current in the motor-circuits, complete control is attained.

In other contemporaneous applications I have shown, described, and claimed electric-railway-train systems each possessing some peculiar feature and adapted to employ some special form of motor to propel the car. In the present application, however, I broadly claim the combination of a suitable supply-circuit, a plurality of traveling motors, a local circuit or circuits including all of said motors and traveling therewith, and a current distributing, modifying, or tension-reducing device moving with the motors and supplying currents thereto, and a traveling connection between the primary of the current-controlling device of the supply circuit.

The construction and arrangement of an organization embodying the invention will be hereinafter set forth.

In the drawings, Figure 1 is a view in elevation, partly broken away, showing two cars of a train arranged and equipped according to my invention. Fig. 2 is a diagrammatic view showing a system of train-circuits and means for reversing all the motors.

In said drawings, A is the motor-car, and B is the first car, of the train, the car B being mechanically connected to the car A by the usual couplings. The car B is provided with motors C D, which may be of the ordinary continuous-current type, and, as indicated, do not differ materially from the propelling mechanism used for the propulsion of street-railway cars. This is, however, only shown by way of illustration, the particular form or number of motors supplied to each car forming no part of the invention.

The motor-car A, in addition to propelling-motors C D, is also provided with current-collecting devices, which, as here shown, comprise an upward-pressure trolley-arm E, provided with contact-shoes *e*, engaging a bare suspended conductor P, which, as shown, constitutes one side of the supply-circuit. The track-rails N are in the present instance electrically connected to form the return side of the main supply-circuit, the current being led therethrough through the wheels *a a'*, moving upon said rails, or through suitable contact blocks or brushes, also moving upon said rails, and provided for the purpose of insuring a better contact therewith. The current collected by the traveling contacts *e e* is carried by a suitable connection extending along the trolley-arm E, said connection terminating at and being attached to a switch-lever F, which is pivoted in operative relation to the terminals of a resistance G. From the resistance G the main supply-current passes by conductor *f* to one member *g* of a two-way switch. The switch-lever *g* is capable of two positions—one in contact with the terminal *f*, the other with terminal f^2. The second switch-lever *g'* is also capable of two operative positions—viz., in contact with the terminal f^2, as seen, or with the terminal f^3.

H indicates a motor-generator, which, as herein shown, comprises an annular exterior field-magnet mounted upon a suitable base *h*, and formed of any desired number of coils I of magnetizing-conductor wound upon suitable cores and alternating with polar extensions I'. Within the field-magnet are rotatively mounted two armatures sustained upon the same shaft. The armatures are of any desired continuous-current type, but are wound for different current effects. The said armatures should be about equal in size. One armature J is to be wound to receive the supply-current and to be operated thereby as a motor. The said armature is provided with a commutator *j*, upon which bear positive and negative commutator-brushes, which, as here indicated, are connected, the positive by conductors 1 and 2 to terminals $f' f^3$ of the switch and the negative by conductor 3 to the switch-terminal f^2. The field-magnet circuits of the motor-generator start from the switch-lever *g'*, extending by conductor 4 to one terminal of said circuit, after traversing which the current issues by conductor 5, which is connected to the axle or other metallic part in connection with the wheel *a*, through which it reaches the track N. All

the train-motors being started and stopped from a single point, it remains but to provide means for reversing the direction of rotation thereof in order to place them entirely under the control of the operator in charge of the motor-car. The motors may be reversed in many different ways; but I prefer to employ in connection with the present system the reversing mechanism shown and described in my patent, No. 352,167, November 9, 1886.

It will be understood that I adapt to my present purpose any and all of the means shown and described in my aforesaid patent; but for convenience I have illustrated one form only, the same being seen in Fig. 2 hereof. In said figure the main positive and negative conductors L *l* are seen extending from the generative part of the motor-generator, and between said conductors the field-magnet coils M′ of a number of motors C′ C^2 C^3 C^4, representing the motors of a train of cars, are connected by branch conductors *m m′*. The armatures O of the several motors, though supplied with current from the same source, are connected thereto in a somewhat different manner. A set of auxiliary circuit-conductors P′ N′ is connected to the main conductors L *l*, or to the commutator-brushes of the generator-armature K, through a reversing-switch Q, and the armatures of the motors O and of the motors C′ C^2 C^3 C^4 are connected in multiple arc between the said conductors P′ N′ by branch conductors *p n* extending between said conductors and the commutator-brushes thereof.

It will be understood that by means of the reversing-switch Q the current can be made to flow in the armatures of the said motors in either direction with respect to that in the field-magnets thereof and the motors be thereby reversed at will.

In Fig. 1 I have indicated the general course of the conductors of the local circuit, and have not shown connections between said circuit and the motors C D, the same being fully shown in Fig. 2, and the positions of the motors C D precluding clear illustration of the connections.

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

1. An electric-railway-train system comprising a supply-circuit carrying current of relatively high tension along the line of way, a motor-car provided with a current-converter arranged to receive and be operated by the high-tension current, one or more vehicles connected and moving with the motor-car and carrying conductors connected to form a local circuit supplied by the converter with current of relatively low tension, and propelling-motors upon a plurality of the vehicles, all connected in and supplied with current by the local circuit.

2. In an electric-railway-train system, a circuit supplying continuous current of relatively high tension extending along the line of way, a traveling vehicle, a continuous-current converter arranged to give current of variable electro-motive force, one or more additional vehicles carrying a local circuit or circuits arranged and connected to receive the secondary currents of the converter and traveling therewith, a motor or motors in said local circuit and adapted to propel the vehicle or vehicles, and a traveling connection between the supply-circuit and the primary of the converter.

3. In an electric-railway-train system, a continuous-current-supply circuit extending along the line of way, a motor-car, a continuous-current coverter upon said car arranged to give current of variable electro-motive force, a local circuit or circuits arranged and connected to receive the secondary current of the converter and traveling therewith, a continuous-current motor or motors in said local circuit and adapted to propel the vehicle or vehicles, a traveling connection between the supply-circuit and the primary circuit of the converter, and means in said primary circuit for conveying the supply of current to the local circuit.

4. In an electric-railway system, the combination of a relatively high potential supply-circuit along the line of way, one or more traveling continuous-current motors, a local circuit including all of said motors and traveling therewith, a traveling tension-reducing device moving with the motors and supplying current of reduced tension to the local circuit, and a traveling connection between the primary of the tension-reducing device and the supply-circuit.

5. In an electric-railway-train system, the combination, with a secondary source of current traveling therewith, of a circuit extending throughout the train, a plurality of electric motors arranged and adapted to propel the train, and circuits and connections whereby all the motors can be simultaneously thrown into operation in the desired direction.

6. In an electric-railway-train system, the combination, with a secondary source of current traveling therewith, of a local circuit extending throughout the train from said secondary source of current and including the field-magnet circuits, a plurality of motors carried by the train and arranged to propel the same, a separate local circuit extending from the said secondary source and including the armature-circuits of the propelling-motors, and a current-reversing switch in one of said motor-circuits whereby the direction of rotation of all the motors can be controlled from a single point.

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

CHARLES J. VAN DEPOELE.

Witnesses:

JOHN W. GIBBONEY,

CHAS. L. STURTEVANT.