(No Model.)

G. W. VON SIEMENS.

ELECTRIC RAILWAY SYSTEM.

No. 502,539. Patented Aug. 1, 1893.

Fig. 1.

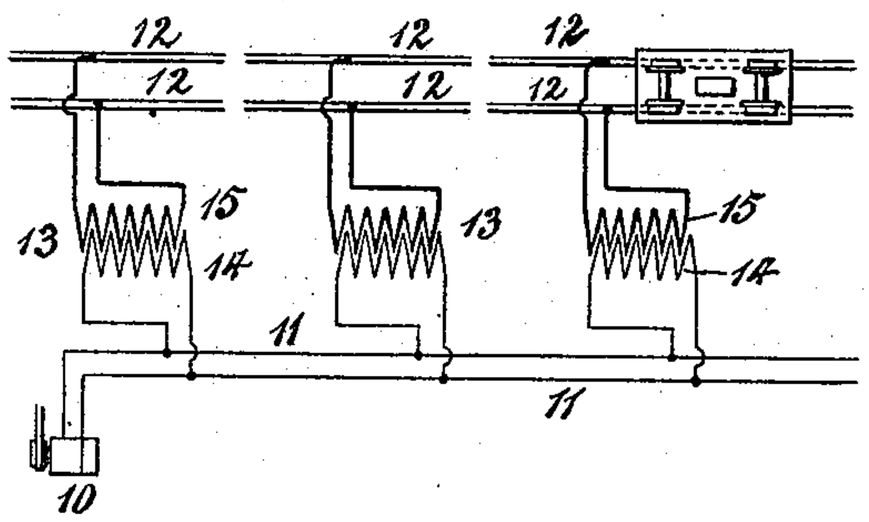


Fig. 2.

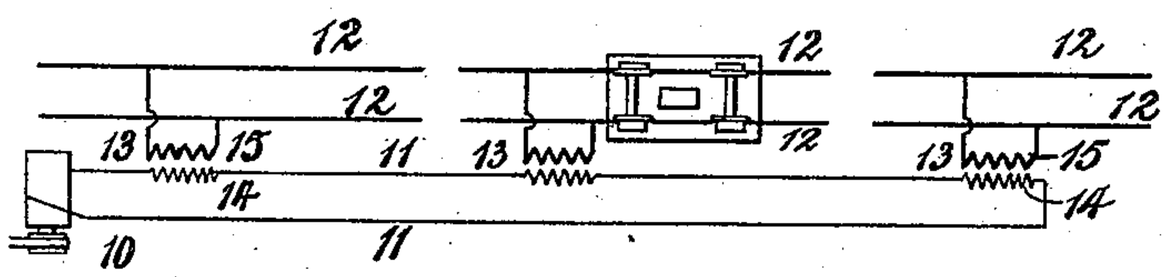


Fig. 3.

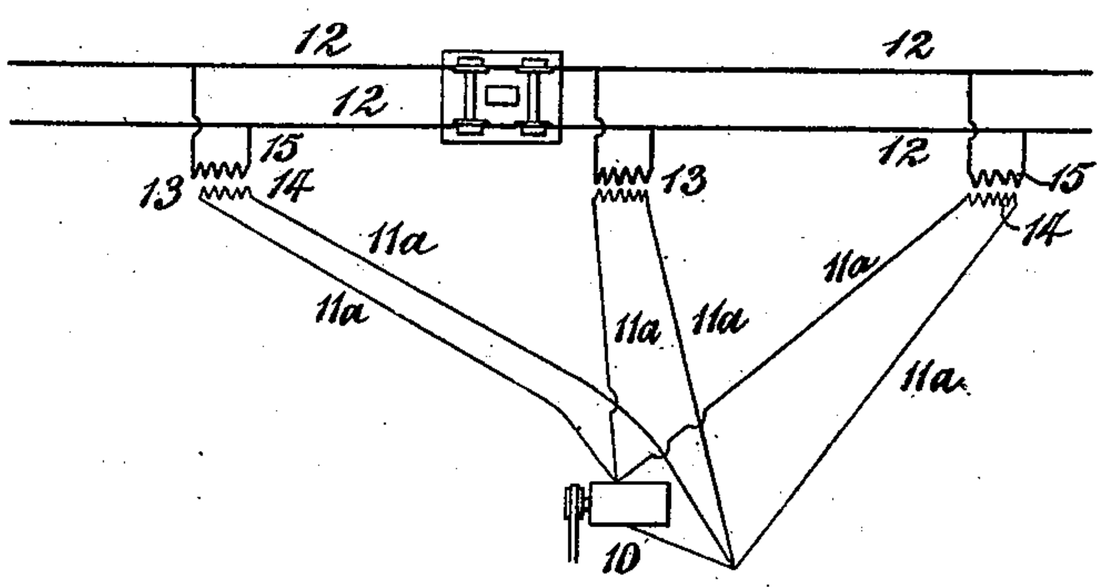


Fig. 4.

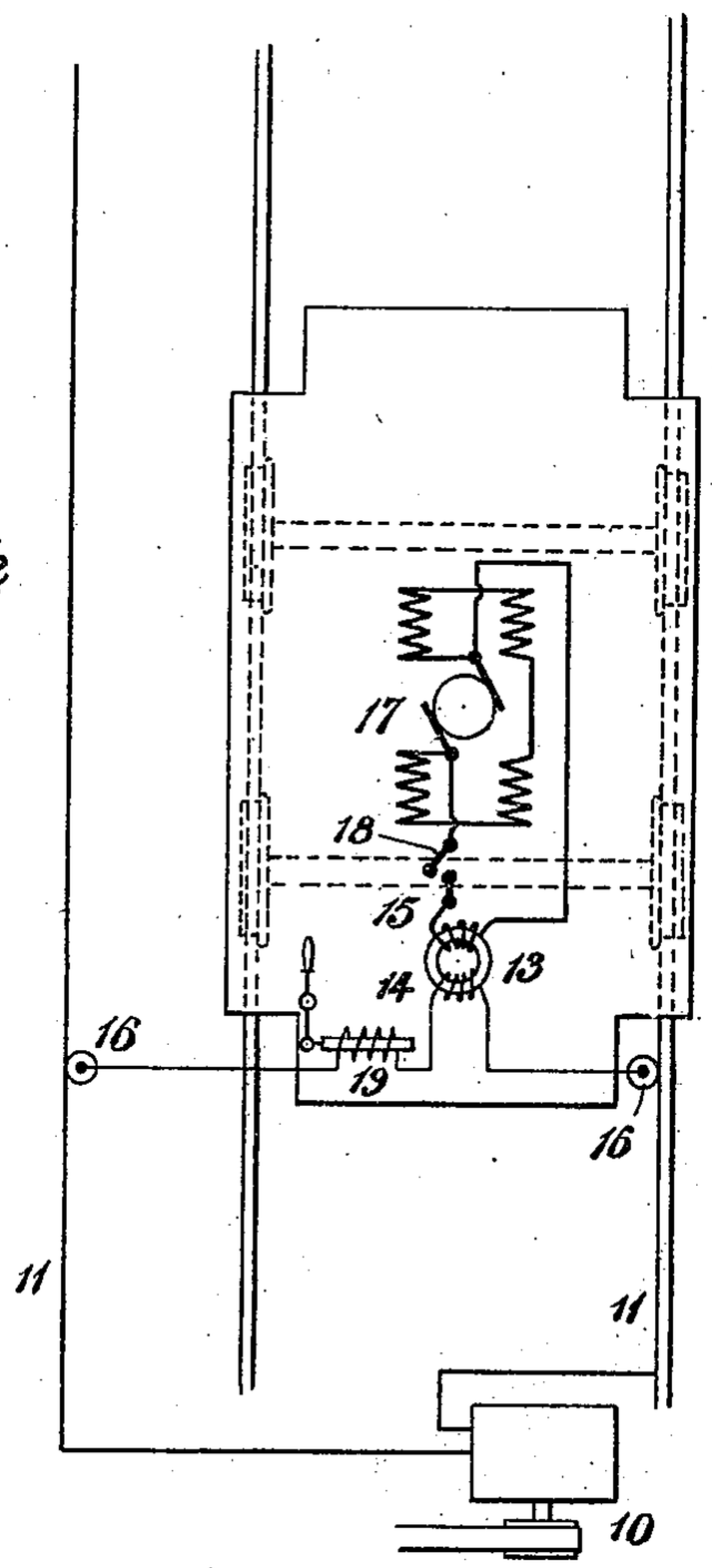
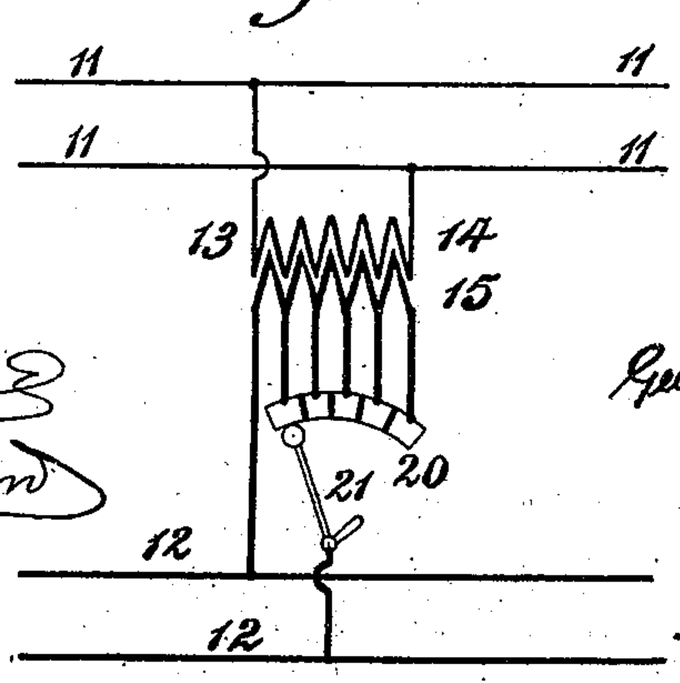


Fig. 5.



WITNESSES:
John E. Deemer
Timothy L. Dillon

INVENTOR
Georg Wilhelm von Siemens

BY
Geo. H. Graham
ATTORNEY

UNITED STATES PATENT OFFICE.

GEORG WILHELM VON SIEMENS, OF BERLIN, GERMANY, ASSIGNOR TO SIEMENS & HALSKE, OF SAME PLACE.

ELECTRIC-RAILWAY SYSTEM.

SPECIFICATION forming part of Letters Patent No. 502,539, dated August 1, 1893.

Application filed March 29, 1893. Serial No. 468,177. (No model.) Patented in Austria-Hungary August 7, 1886, Nos. 31,923 and 2,522 and Nos. 570,681 and 2,394, and in England August 26, 1886, No. 10,926.

To all whom it may concern:

Be it known that I, GEORG WILHELM VON SIEMENS, a subject of the Emperor of Germany, residing at the city of Berlin, in the Empire of Germany, have invented new and useful Improvements in Electric Railways, (for which I have obtained Letters Patent as follows: in England, No. 10,926, dated August 26, 1886, and in Austria-Hungary, Nos. 31,923 and 2,522 and Nos. 570,681 and 2,394, dated August 7, 1886,) of which the following is a specification.

The use of transformers, or secondary generators for transmitting electrical energy, offers the advantage that a much higher tension may be employed than is possible with transmission by continuous current, so that considerable energy can be transmitted through great distances by means of comparatively small conductors, while at the same time the regulation of the power of the motor is capable of being effected much more easily.

For the purposes of this invention, any known construction of alternate current machine is employed for generating the current, while for the motor to be driven by the current, there is employed a dynamo machine that can produce continuous currents.

In applying this invention to electric railways, in which the motors on the carriage receive the current from the traffic rails, or from conductors extending alongside of said rails, the transformers are employed as follows: Transformers are placed at certain distances apart along the line of traffic rails, the primary coils receiving the current from the generators, being arranged either in parallel arc or in series with the conductors therefrom, or each having a separate circuit, while the terminals of the secondary coils are connected respectively to the two traffic rails, when these are used as the conductors, or to the separate working conductors, when these are employed. The traffic rails, or the working conductors may be continuous and fed from all of the transformers, or divided into sections, and each section fed from one transformer, or on the carriage may be placed a transformer whose primary coils are connected in the well known manner, through sliding or rolling contacts to the conductors which convey the currents from the generator thereto, while the secondary coils convey induced currents to the electro-motor on the carriage. It is preferred to arrange the transformers either in parallel arc or on separate circuits, as by such means only can an automatic regulation thereof be obtained. By the automatic or non-automatic regulation of the alternate current machine, the tension at the terminals of the primary coils would then be always constant.

In the accompanying diagrams which illustrate my invention, similar numerals of reference indicate like parts.

Figure 1 shows a number of transformers coupled in parallel between the feeder conductors from the generator and the working conductors of the system. Fig. 2 shows a number of transformers with their primary coils in series with the feeder conductor from the generator, and their secondary coils connected to separate sections of the working conductors. Fig. 3 shows the transformers arranged in separate feeding circuits from the generator. Fig. 4 shows a carriage, on which is mounted a motor, a transformer having its primary coil in parallel through movable contacts with the feeder conductors from the generator, and a current modifying coil in the primary; and further, shows the motor connected to the secondary coil of the transformer. Fig. 5 shows one of my methods of regulating the transformer, and it consists in means for varying the number of secondary coils in action, according to the demands of the load.

In the diagrams, 10 represents any suitable generator of alternating current; 11, the feeder conductors from and to the generator. In Fig. 4, these conductors serve as the working conductors.

12 are the working conductors. These conductors may consist of the rails of a tramway, or of one rail and a conductor placed parallel thereto, or there may be separate, distinct conductors placed above, below, or otherwise

disposed relative to the rails upon which the vehicle moves. They may be continuous or divided into sections, as desired.

13 is a transformer of the usual type having primary and secondary coils 14 and 15.

In Fig. 1, the transformers are shown coupled in parallel between the feeder conductors 11 and the working conductors 12: that is to say, the primary coils of the transformers are connected to the conductors 11, and the secondary coils 15 to the conductors 12.

In Fig. 2, the transformers 13 are arranged in series. All the primary coils are in series with the conductor 11, while the secondary coils are each connected by itself to a single section of the working conductors 12.

In Fig. 3, the primary coils of the separate transformers are fed through separate feeder conductors 11^a, while the secondary coils are connected in parallel arc with the continuous conductors 12.

In each of the arrangements shown, the transformers are separated at a distance from each other along the line of the road. This distance will depend upon the character of the currents transmitted, length of the road, &c.

In Fig. 4, the arrangement is somewhat different;—instead of a number of transformers arranged along the line of the road, a single transformer 13 is placed upon the vehicle. In this case, the primary coil 14 of the transformer is connected to sliding or rolling contacts 16, which bear respectively, one, for instance, upon one of the feeder conductors 11 and the other upon the other of the feeder conductors, or upon a rail suitably connected to one of the feeder conductors. The secondary coil 15 has its terminals connected to the motor 17. 18 is a switch for breaking the circuit between the secondary of the transformer and the motor. This switch can be arranged in a manner well understood, to reverse the current through the motor. Any suitable type of motor may be used *i. e.* one adapted to be worked with alternating currents, which may be an alternating motor, or a machine which, when used as a dynamo, will generate constant currents; that is to say, a machine of the Siemens or Gramme type, having its field magnets subdivided by making them of laminated plates.

In Fig. 5, 11, 11 indicate the main or feeder conductors; 13 is the transformer in diagram; 12, 12 are the working conductors; 14 is the primary conductor of the transformer, and 15 is the secondary conductor of the transformer. The coil of the secondary conductor 15 is divided into sections which are connected to the contact plates 20. 21 is a contact arm which moves over these contact plates 20. It will be noticed that in the extreme left hand position of the contact arm 21 only one of the secondary coils is in circuit, while in the extreme position to the right hand, all the coils of the secondary are in circuit; and in an intermediate position, an intermediate number of coils will be in action, according to the position of said contact arm. This is a very simple and efficient method of regulation, and tends to save much energy which would otherwise be wasted.

In the arrangement shown in Figs. 1 and 3, where the secondaries of the transformers are in parallel with the feeder conductors, all of said transformers will be active at the same time, and each one will do work in proportion to the resistance of its secondary circuit. Owing, however, to the motion of the carriage, this resistance will vary according to the distance of the carriage from the particular transformer from which it is receiving current. The difference of potential at the terminals of the secondary coils will have to be taken comparatively low, having regard to the difficulty of effecting a perfect insulation of the traffic rails, or separate conductors which distribute current.

The above described system,—as all other systems for the transmission of energy for a similar purpose—requires that a regulating device be used to determine the speed of the carriage, &c. For this purpose I make use of the following device:

19, Fig. 4, diagrammatically represents a wire coil or bobbin provided with a movable iron core. For electrical reasons, which are readily understood, if the iron core is introduced into the bobbin, a counter electro-motive force to that traversing the primary of the transformer will be induced, and will therefore cut down the current in the primary.

Instead of using this device, various other well known means for modifying the current transmitted to the motor on the vehicle may be employed.

I do not limit myself to the use of any particular kind of contacts, as any suitable means may be employed for putting the electro-motor or motors on the vehicles in operative relation with the source of energy.

I do not in this application claim broadly the employment of a current modifying transformer in an electric railway system of the character described, as such feature has been made the subject of a companion application, Serial No. 468,176, filed March 29, 1893.

Having thus described my invention, I claim—

1. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle, an electro motor adapted to be actuated by alternating currents, and a transformer located on said vehicle having its primary coil in operative relation to said feeder conductors and its secondary coil electrically connected to the motor.

2. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle, an electro motor adapted to be actuated by alternating currents, a transformer located on said vehicle having its primary coil connected to said feeder conductors and its secondary coil electrically connected

to the motor, and means for modifying the current supplied to the motor.

3. In an electric railway, the combination of a source of alternating currents, conductors extending therefrom, a number of vehicles moving along the said line of way, transformers located on said vehicles, motors also located on said vehicles and electrically connected with the secondary circuits of the transformers, and means for conveying current from the conductors leading from the generator to the primary circuits of the transformers.

4. In an electric railway, the combination of a source of alternating currents, conductors extending therefrom, a number of vehicles moving along the said line of way, transformers located on said vehicles, motors also located on said vehicles and electrically connected with the secondary circuits of the transformers, means for conveying current from the conductors leading from the generator to the primary circuits of the transformers, and means for regulating the supply of energy transmitted through the primary coil of the transformer.

5. In an electric railway, a source of alternating currents, conductors extending therefrom, a moving vehicle or vehicles upon the line of railway, transformers located on said vehicles connected to said conductors, motors also located on said vehicles, means for conveying current from the generator to the motors, and a counter-electro motive force coil also located on the vehicles to regulate the supply of energy to the motor.

6. In an electric railway, a source of alternating currents, conductors extending therefrom, a moving vehicle or vehicles upon the line of railway, transformers located on said vehicles connected to said conductors, motors also located on said vehicles, and a counter-electro motive force coil connected to the primary coil of the transformer, said motive force coil having an adjustable core to regulate the supply of energy to the motor.

7. In an electric railway, a source of alternating currents, conductors extending therefrom, a vehicle or vehicles moving along the line of railway, transformers connected to said conductors and located on said vehicle or vehicles, motors also located on said vehicle or vehicles, and traveling contacts moving along the conductors and carried by the vehicle or vehicles, said contacts being in circuit with the primary of the transformer, the secondary circuits of the transformer being connected to the motors.

8. In an electric railway, a source of alternating currents, overhead conductors connected to said source and extending along the line of railway, a vehicle or vehicles moving along the line of railway, transformers located on said vehicle or vehicles, motors also located on said vehicle or vehicles, means for conveying the current from the overhead conductors to the transformers, and means to regulate the supply of energy to the motors.

9. In an electric railway, a source of alternating currents, overhead and surface conductors connected to said source and extending along the line of railway, a vehicle or vehicles moving along the line of railway, transformers located on said vehicle or vehicles, motors also located on said vehicle or vehicles, means for conveying the current from the overhead and surface conductors to the transformers, and means to regulate the supply of energy to the motors.

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

GEORG WILHELM VON SIEMENS.

Witnesses:

GUSTAV STENZEL,

MAX WAGNER.