(No Model.)

G. W. VON SIEMENS.

CONVERTER SYSTEM FOR ELECTRIC RAILWAYS.

No. 502,538. Patented Aug. 1, 1893.

Fig. 1.

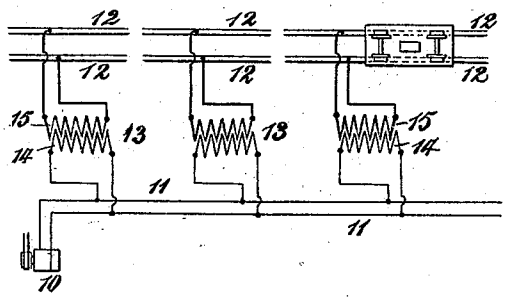


Fig. 2.

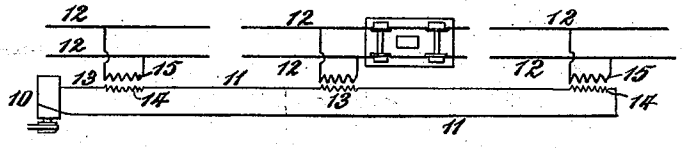


Fig. 3.

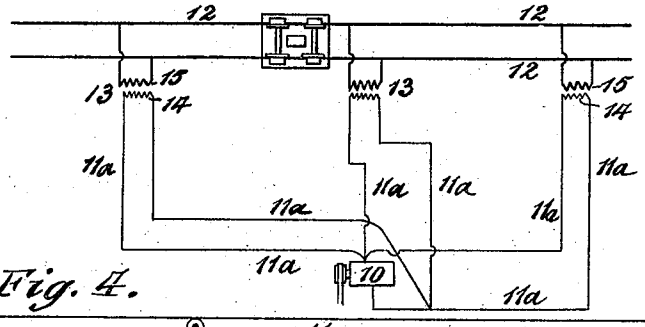
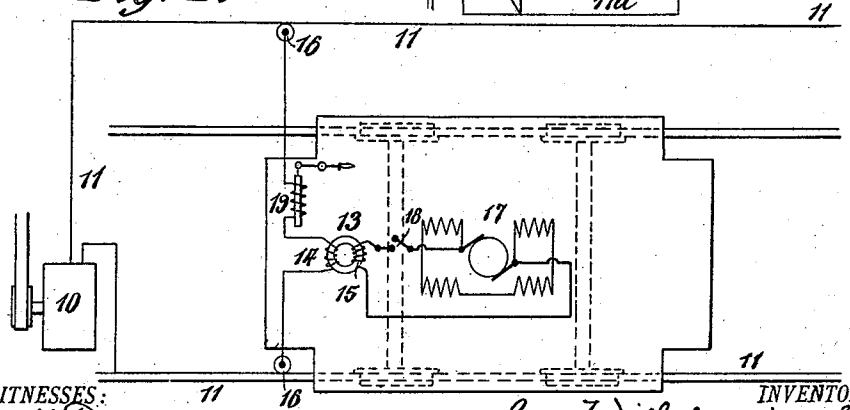


Fig. 4.



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CONVERTER SYSTEM FOR ELECTRIC RAILWAYS.

SPECIFICATION forming part of Letters Patent No. 502,538, dated August 1, 1893.

Application filed March 29, 1893. Serial No. 468,176. (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 German Empire, 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; 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 carriages 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 generator 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 electromotor 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 are 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.

In the diagrams, 10 represents any suitable generator of alternating currents; 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 relatively 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 cou-

pled 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 conductors 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 sub-divided by making them of laminated plates.

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 make no claim in this application to the employment, in an electric railway system of the character described, of a transformer located on the vehicle, as this feature has been made the subject of a companion application Serial No. 468,177, filed March 29, 1893.

Having thus described my invention, I claim—

1. In an electric railway, a source of alternating currents, a moving vehicle upon a line of railway, a motor mounted upon said vehicle to propel the same, an inductional transformer interposed between the generator and motor for modifying the current from the generator, and means for supplying energy from the generator to the motor, substantially as described.

2. In an electric railway, a source of alternating currents, conductors extending from said source, a number of moving vehicles upon a line of railway, motors mounted on said vehicles to propel the same, and a number of current modifying inductional transformers connected to said conductors and interposed between the generator and the motors for modifying the current supply from the generator to the motors.

3. In an electric railway, the combination of an alternating generator, a vehicle or vehicles moving along a track, a motor or motors mounted upon said vehicle or vehicles, an inductional transformer or transformers interposed between the generator and the motors for changing the tension of the current from the generator, and means for regulating the supply of energy to the motors.

4. In an electric railway, the combination of an alternating generator, a moving vehicle or vehicles upon a line of railway, a motor or motors mounted upon said vehicle or vehicles, inductional devices for changing the tension of a current interposed between the generator and the motors, and connections composed wholly or in part of the rails for carrying the current from the tension changing devices to the motors.

5. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a number of transformers distributed along the way having their primary coils

electrically connected with said feeder conductors, working conductors also extending along the way and electrically connected with the secondary coils of said transformers, a vehicle or vehicles upon the said line of railway, an electric motor or motors on said vehicle or vehicles, and means for supplying current from the working conductors to the motor or motors in such a way as to energize said motor or motors and cause them to propel the vehicle or vehicles.

6. In an electric railway, an alternating generator, feeder conductors extending therefrom, a number of transformers distributed along the way and connected to the feeder conductors in parallel arc, working conductors extending along the way and electrically connected with the secondary coils of the transformers, a vehicle or vehicles on the said line of railway, and electric motor or motors on said vehicle or vehicles which receive energy from the working conductors in such a way as to be energized by the current from said working conductors.

7. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a series of transformers distributed along the way and having their primary coils electrically connected with said feeder conductors, working conductors also extending along the way and electrically connected with the secondary coils of said transformers, a vehicle, and an electro motor on said vehicle through which an alternating current is transmitted, in operative relation with said working conductors.

8. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a series of transformers distributed along the way and having their primary coils electrically connected with said feeder conductors, sectional working conductors also extending along the way and electrically connected with the secondary coils of said transformers, a vehicle, and an electro motor on said vehicle through which an alternating current is transmitted, in operative relation with the section of the working conductors over which it is traveling.

9. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a series of transformers distributed along the way and having their primary coils electrically connected in parallel arc with said feeder conductors, working conductors also extending along the way and electrically connected with the secondary coils of said transformers, a vehicle, and an electro-motor on said vehicle, through which an alternating current is transmitted, in operative relation with said working conductors.

10. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle having an electro motor mounted thereon, through which an alternating current is transmitted, and a transformer interposed between said feeder conductors and said electro motor and in operative relation therewith.

11. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle having an electro motor mounted thereon, through which an alternating current is transmitted, a transformer interposed between said feeder conductors and said electro motor, and in operative relation therewith, and means for modifying the current transmitted through the electro motor.

12. In an electric railway, a source of alternating currents, feeder conductors extending therefrom, a vehicle having an electro motor mounted thereon, through which an alternating current is transmitted, a transformer interposed between said feeder conductors and said electro motor, and in operative relation therewith, and means carried by the vehicle for varying the current transmitted through the motor.

13. In an electric railway, the combination with a generator of alternating currents, a vehicle having a propelling electro motor mounted thereon, through which an alternating current is transmitted, and a current transformer having a primary and a secondary coil, said primary coil in operative relation with said generator, and said secondary coil in operative relation with said electro motor.

14. In an electric railway, the combination with a generator of alternating currents, a vehicle having a propelling electro motor mounted thereon, through which an alternating current is transmitted, a current transformer having a primary and a secondary coil, said primary coil in operative relation with said generator, and said secondary coil in operative relation with said electro motor, and means for modifying the current transmitted through the motor.

15. In a system of electrical distribution, a source of alternating currents, feeder conductors extending therefrom, a series of transformers distributed along said feeder conductors and having their primary coils electrically connected thereto, sectional working conductors having each separate section connected with the secondary coil of one transformer, and translating devices in said section through which an alternating current is transmitted.

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

GEORG WILHELM VON SIEMENS.

Witnesses:
GUSTAV STARZEL,
MAX WAGNER.