(No Model.) 2 Sheets—Sheet 1.

L. H. NASH.

METHOD OF AND APPARATUS FOR ELECTRIC PROPULSION.

No. 576,145. Patented Feb. 2, 1897.

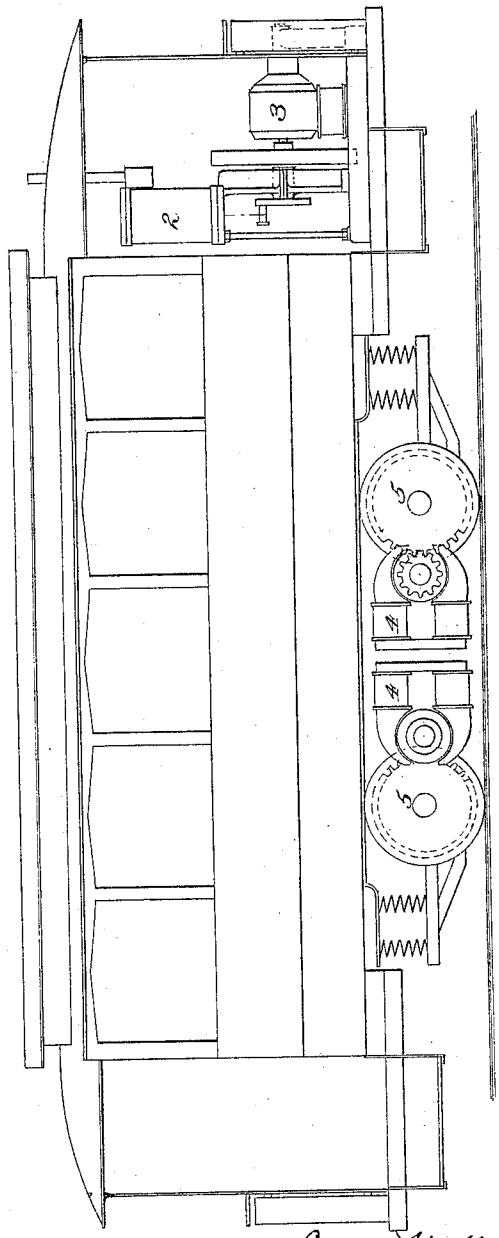

Fig. 1.

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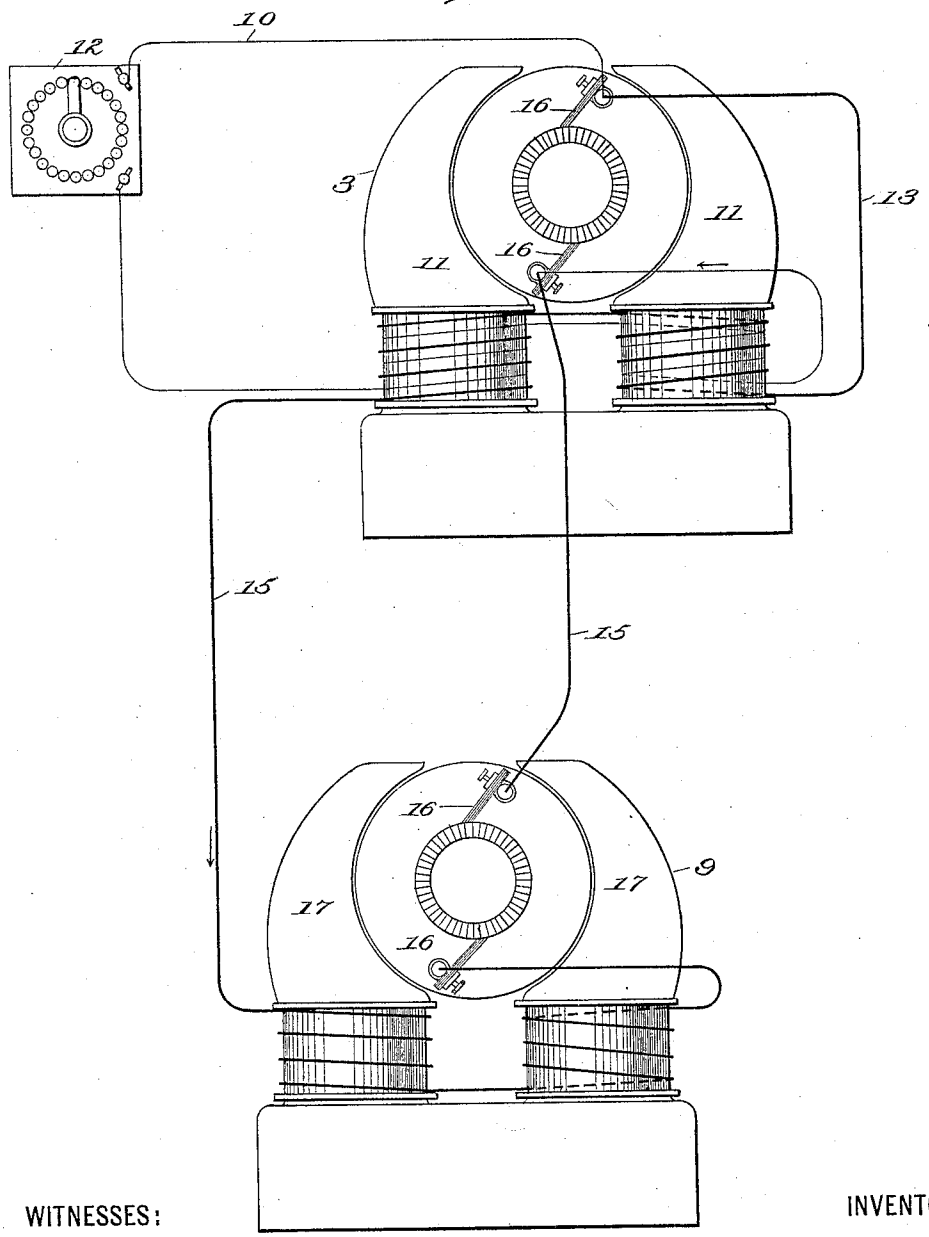
Fig. 2



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METHOD OF AND APPARATUS FOR ELECTRIC PROPULSION.

SPECIFICATION forming part of Letters Patent No. 576,145, dated February 2, 1897.

Application filed November 16, 1895. Serial No. 569,147. (No model.)

To all whom it may concern:

Be it known that I, LEWIS HALLOCK NASH, a citizen of the United States, and a resident of South Norwalk, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Methods of and Apparatus for Electric Propulsion, of which the following is a specification.

My invention relates to certain improvements in the method of and apparatus for electric propulsion, as designated in the claims concluding this specification.

In the accompanying drawings, Figure 1 shows an ordinary street-car with apparatus involving my invention. Fig. 2 shows diagrammatically the dynamo and motor carried on the car shown in Fig. 1.

My invention is applicable not only to the propulsion of street-cars, but may be used in the propulsion of road-carriages, boats, and other vehicles.

The following is a description of the drawings, which show my invention applied in one of the many forms in which it may be embodied.

Referring to Fig. 1, 2 is an engine or prime mover of any suitable type. I have shown a gas or petroleum engine, which is the form I at present prefer. 3 is a dynamo connected to and driven by the engine 2. 4 4 are motors arranged beneath the cars and connected with the wheels 5 5 in the ordinary manner.

Referring to Fig. 2, 3 is a dynamo, and 9 is a series-wound motor driven by the current produced thereby. 10 is a shunt-winding on the magnets 11 11 of the dynamo, having a resistance-box 12 connected in circuit. 13 is a series winding on the said field-magnets coiled in the opposite direction to the shunt-winding 10. 15 15 are the main conductors, connected with brushes 16 16 of the motor, passing around the field-magnet 17 17 in series.

The operation of the device shown in the drawings may be thus described: The prime mover is preferably, although not necessarily, to be run at a substantially constant speed. Supposing it to be so running at a given speed, developing its full power, while the car is moving on a level part of the track, when the car encounters a grade it is plain that the power available would be insufficient to propel it up the grade at the same speed, while it might be amply sufficient to propel it up the grade at a diminished speed. Under conditions of increased work it is desirable that the motor be supplied with a larger current. If, however, this additional current had to be furnished by the prime mover at the same voltage as before, it would require a larger expenditure of energy than we have assumed is available. By the arrangement shown in the drawings, however, additional current is at this time automatically furnished to the motor at a correspondingly-diminished electromotive force, and hence without the expenditure of more energy. The car simply slows down to the point at which the prime mover can drive it up the grade. This result is obtained automatically thus: The shunt-winding 10 is made of a suitable gage and length of wire, so as unaided to energize the magnets 11 to the maximum degree, but preferably somewhat below the point of saturation. As current flows through the main line the magnetization of the magnets diminishes in proportion as the current in the main line increases, this being due to the fact that the windings of the shunt and the series coils on the magnets of the dynamo are in opposite directions. Assuming that the proportion existing between this shunt and series winding is such that when the car is on a level stretch of road a suitable current is being supplied to the motor 9, it is plain that as the motor slows down on encountering a grade the current flowing through the series coils will increase and will thereby diminish the magnetization of the field-magnets 11, which in turn will reduce the electromotive force of the current delivered to the motor. Hence, although more amperes of current are supplied to the motor, the watts developed by the dynamo, and therefore the work being done by the engine, may not be increased. These windings may, therefore be proportioned in such a way that there will be an instantaneous self-adjustment of the current supplied by the dynamo to the needs of the motor under varying conditions of use. The principles which govern the proportioning of the elements to the conditions of use are now well known and can be readily applied to each case as it arises without fur-

ther description by any competent electrical engineer.

Referring again to Fig. 2 of the drawings, the resistance-box 12 is of ordinary form and placed in the shunt 10. It will readily be seen that by means of this resistance-box the speed of the motor is brought under the control of the motorman, the same self-adjustment between the dynamo and the motor taking place as well when the current in the shunt-winding is diminished by an interposed artificial resistance as when all the resistance is cut out.

The car may be started by cutting out successively resistance-coils, or it may be started by cutting out all the resistance-coils and allowing the full normal amount of current to flow through the shunt 10. Under this latter condition the motor would still start slowly and build up gradually, because at the start a comparatively large current would flow through main conductors at a comparatively low electromotive force, the current reducing in volume and increasing in electromotive force as the speed of the motor increased.

One of the advantages of this method of operation and arrangement of parts is the fact that no current can be generated by the dynamo which is greater than the motor can stand, even if it be at rest, because the windings may be so proportioned that the dynamo will fail under all conditions to generate a current of greater quantity than the motor is designed to utilize.

Instead of controlling the speed of the motor by means of the resistance-box 12 it might be controlled by varying the speed of the engine, since both methods would determine the output of power of the prime mover, and therefore the speed of the motor under given conditions. It is in many cases, however, preferable to control the speed by means of the resistance-box, as the prime mover can then be placed in a position where the attendant need give no attention to it.

In the foregoing specification I have incidentally referred to some of the modifications which might be adopted in practicing my invention; but I have not endeavored to specify all the modifications which might be employed, the object of this specification being to instruct persons skilled in the art to practice the several novel features of my invention in their present preferred forms and to enable them to understand their nature; and I desire it to be distinctly understood that mention by me of a few modifications is not in any way intended to exclude others not referred to, but which are within the spirit and scope of my invention, and that in so far as my invention consists of novel methods these are independent of the mechanism described or of any particular mechanism.

Many of the combinations and details illustrated and above described are not essential to the several features of my invention separately and broadly considered. All this will be indicated in the concluding claims, where the omission of an element or the omission of reference to the detail features of the elements mentioned is intended to be a formal declaration of the fact that the omitted elements or features are not essential to the inventions therein severally covered.

What I claim is—

1. The combination with an electric generator run at a substantially constant speed, of a translating device constructed and arranged to translate into work a constant energy in watts at varying potential and current said generator having on its field-magnets shunt and series coils wound in opposite directions whereby constant watts at varying potential and current are supplied to the work-circuit as the resistance of that circuit varies.

2. The combination of a vehicle, an electric generator having on its field-magnet shunt and series coils, the currents through which flow in opposite directions with a series-wound motor.

3. The combination with an electric generator run at a substantially constant speed of a series-wound motor, said generator having on its field-magnets shunt and series coils wound in opposite directions whereby constant watts at varying potential and current are supplied to the work-circuit as the speed of said motor varies and a variable resistance in said shunt-circuit of said dynamo.

4. The combination with a vehicle of a prime mover, and dynamo operating at a determined speed, an electric motor and means for automatically varying in inverse ratio both the amperes and volts supplied to the motor as the work imposed upon it varies.

5. The method of propelling a vehicle consisting in developing a constant energy in watts in a prime mover carried on the vehicle and of interposing between said prime mover and wheels or other driven element a motor adapted to utilize a constant energy in watts at different speeds.

6. The combination of an electric generator having on its field-magnets shunt and series coils wound in opposite directions whereby constant watts are supplied to the work-circuit under variations of resistance in said circuit, a manually-operated resistance in said shunt-circuit for varying the output of the generator in watts and a translating device constructed and arranged to translate into work a given energy in watts at varying potential and current.

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Witnesses:
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