No. 811,758. PATENTED FEB. 6, 1906.

A. H. ARMSTRONG.

INDUCTION MOTOR CONTROL.

APPLICATION FILED JUNE 28, 1905.

2 SHEETS—SHEET 1.

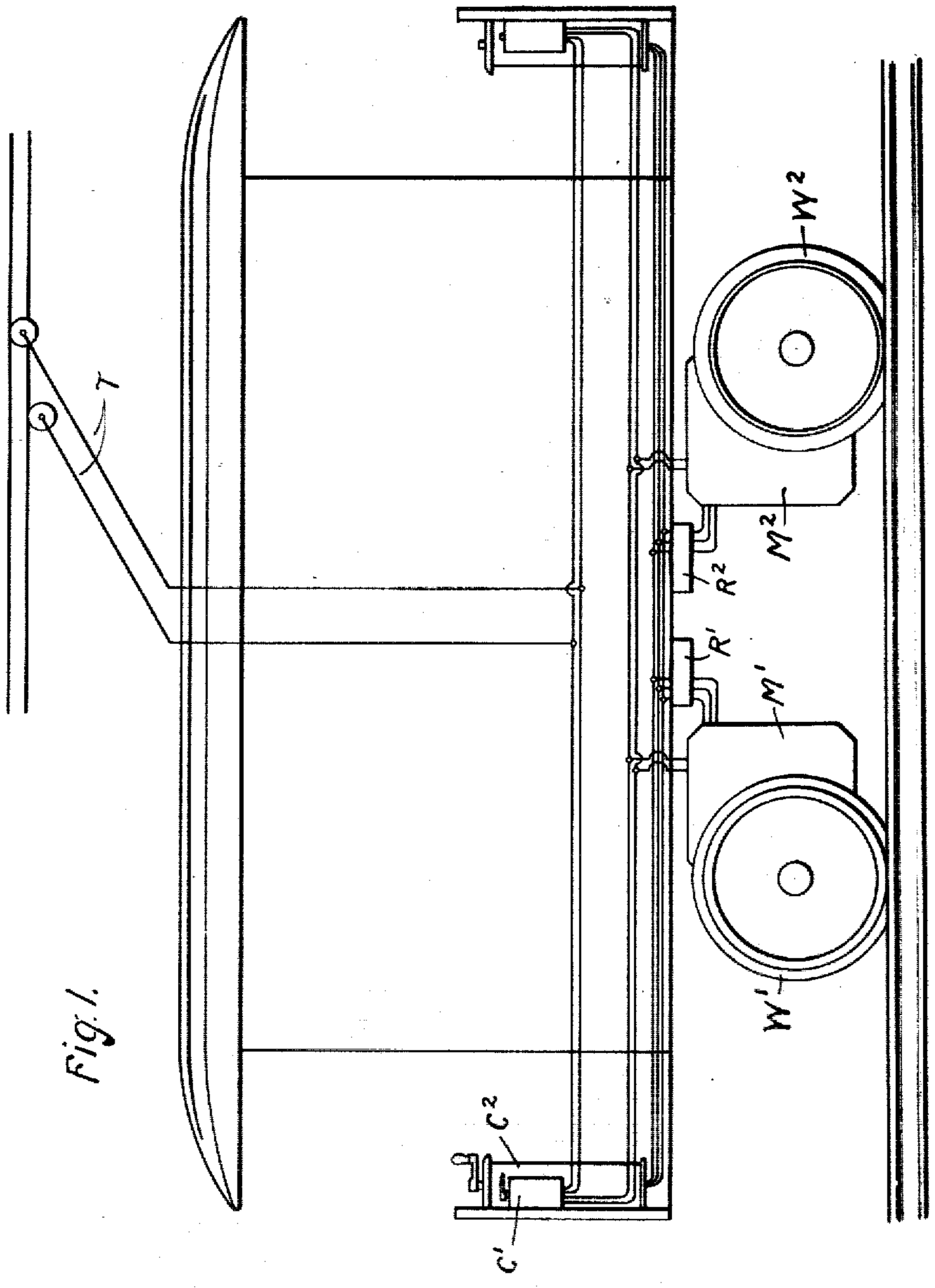

Fig. 1.

Witnesses
J. Ellis Glen
Helen Alford

Inventor:
Albert H. Armstrong
by Albert G. Davis
Atty.

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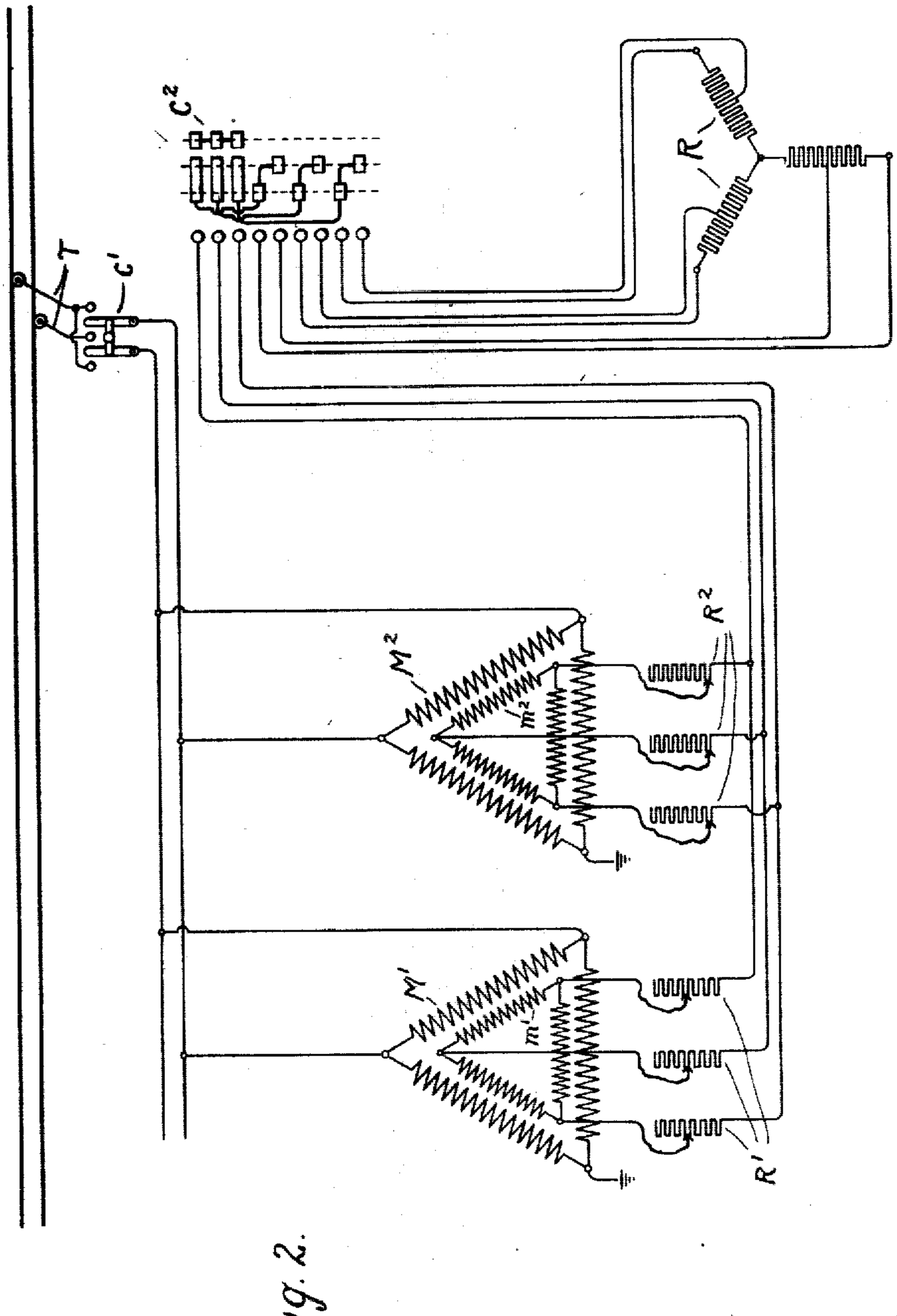

Fig. 2.

Witnesses
J. Ellis Eden.
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UNITED STATES PATENT OFFICE.

ALBERT H. ARMSTRONG, OF SCHENECTADY, NEW YORK, ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

INDUCTION-MOTOR CONTROL.

No. 811,758. Specification of Letters Patent. Patented Feb. 6, 1906.

Application filed June 28, 1905. Serial No 267,341.

To all whom it may concern:

Be it known that I, ALBERT H. ARMSTRONG, a citizen of the United States, residing at Schenectady, county of Schenectady, State of New York, have invented certain new and useful Improvements in Induction-Motor Control, of which the following is a specification.

My invention relates to the control of induction-motors used for propelling railway-vehicles; and its object is to provide means for maintaining an equal distribution of load on the several motors at all times.

An efficient induction-motor is substantially a synchronous machine—that is, it operates normally with a small slip. Consequently if the driving-wheels of a vehicle are of unequal size, as may frequently be the case, due to unequal wear, or if two cars or locomotives with wheels of different size are coupled together in a train the synchronous characteristic of the motors produces an unequal distribution of load. Thus, for instance, if the motors operate at full load with a five per cent. slip and if one driving-wheel is five per cent. smaller than another the motor geared to the larger wheel may be operating at full load with five per cent. slip, while the motor geared to the smaller wheel may be running at synchronism, and consequently doing no work whatever. If the inequality between the wheels is greater than the slip, the motor geared to the smaller wheel may even be operating as a generator, returning power to the line, and thereby acting as a brake to overload further the other motors.

My invention in its broadest aspect consists in providing means for independently adjusting the torque of the several motors, so that the load may be equally distributed at all times.

More specifically stated, my invention consists in the combination with a plurality of motors and a switch for controlling the motors simultaneously of independent adjustable resistances placed near the motors and connected in series with the secondary windings of the several motors, respectively. With this arrangement if the adjustable resistance in series with the rotor-winding of the motor which is connected to the smallest wheel is completely cut out while a certain amount of resistance is left in the secondary circuit of the motor connected to a larger wheel the slip of the latter motor will be increased so that the torque of both motors may be made the same, although they are running at somewhat different speeds.

My invention will best be understood by reference to the accompanying drawings, in which—

Figure 1 shows diagrammatically a car or locomotive driven by induction-motors provided with adjusting means arranged in accordance with my invention, and Fig. 2 is a diagram of circuit connections.

In Fig. 1, M' and M^2 represent two induction-motors mechanically connected to the driving-wheels W' and W^2. The wheel W^2 is represented as smaller than the wheel W', and consequently the motor M^2 must run at a higher speed than the motor M'. The primaries of the induction-motors are connected, through suitable switches C', to the current-collectors, indicated by the trolleys T. The secondaries of the motors are connected in parallel to suitable controlling-switches C^2, by means of which the secondary resistances of the motors may be simultaneously varied to control the speed and torque of the vehicle. R' and R^2 represent adjustable resistances placed near the motors and connected directly in series with their respective secondary windings. By means of these resistances the speed-torque characteristics of the two motors may be adjustable independently, so that they will divide the load equally in spite of the difference in their speeds.

In Fig. 2 I have shown a diagram of the circuit connections. In this figure I have shown the switch C' in the primary circuit arranged as a reversing-switch and the switch C^2 arranged to connect variable portions of resistance R in circuit with the secondary windings of the motors, which are connected in parallel. It will be understood that the particular arrangement of these controlling-switches C' and C^2 forms no part of my present invention, and these switches may be modified in any desired manner to control the motors in any well-known way. The primary windings of the motors are indicated by M' and M^2, respectively, and the secondary windings by m' and m^2. R' and R^2 represent independent adjustable resistances connected in the secondary circuits of the motors. The resistance R^2, which is in the secondary circuit of the motor M^2, which is

supposed to be connected to the smaller driving-wheel, is shown entirely cut out of the circuit, while a portion of the resistance R′ is left in circuit with the secondary winding m'. With this arrangement the two motors will have equal torques at speeds differing in amount, depending on the design of the motors and the amount of resistance R′ in the secondary winding m'.

I do not desire to limit myself to the particular construction and arrangement of parts here shown, but aim in the appended claims to cover all modifications which are within the scope of my invention.

What I claim as new, and desire to secure by Letters Patent of the United States, is—

1. In combination with a vehicle, a plurality of induction-motors mechanically connected to the driving-wheels of said vehicle, means under the control of the motorman for controlling said motors simultaneously, and means for adjusting the relative torques of said motors.

2. In combination with a vehicle, a plurality of induction-motors mechanically connected to the driving-wheels of said vehicle, means under the control of the motorman for controlling said motors simultaneously, and means for adjusting independently the relative resistances of the secondary circuits of said motors.

3. In combination with a vehicle, a plurality of induction-motors mechanically connected to the driving-wheels of said vehicle, a controlling-switch adapted to vary simultaneously the resistances in the secondary circuits of said motors to control the speed of the vehicle, and means for adjusting independently the relative resistances in the secondary circuits of said motors to vary the relative speed-torque characteristics of said motors.

4. In combination with a vehicle, a plurality of induction-motors mechanically connected to the driving-wheels of said vehicle, a switch under the control of the motorman for controlling said motors simultaneously, and independent adjustable resistances placed near the several motors and connected in their secondary circuits.

5. In combination with a vehicle, a plurality of induction-motors mechanically connected to the driving-wheels of said vehicle, the secondary windings of the several motors being connected electrically in parallel, a controlling-switch in the secondary circuit adapted to vary the resistance therein, and independent adjustable resistances connected in series with the several rotor-windings respectively.

In witness whereof I have hereunto set my hand this 27th day of June, 1905.

ALBERT H. ARMSTRONG.

Witnesses:

BENJAMIN B. HULL,

HELEN ORFORD.