

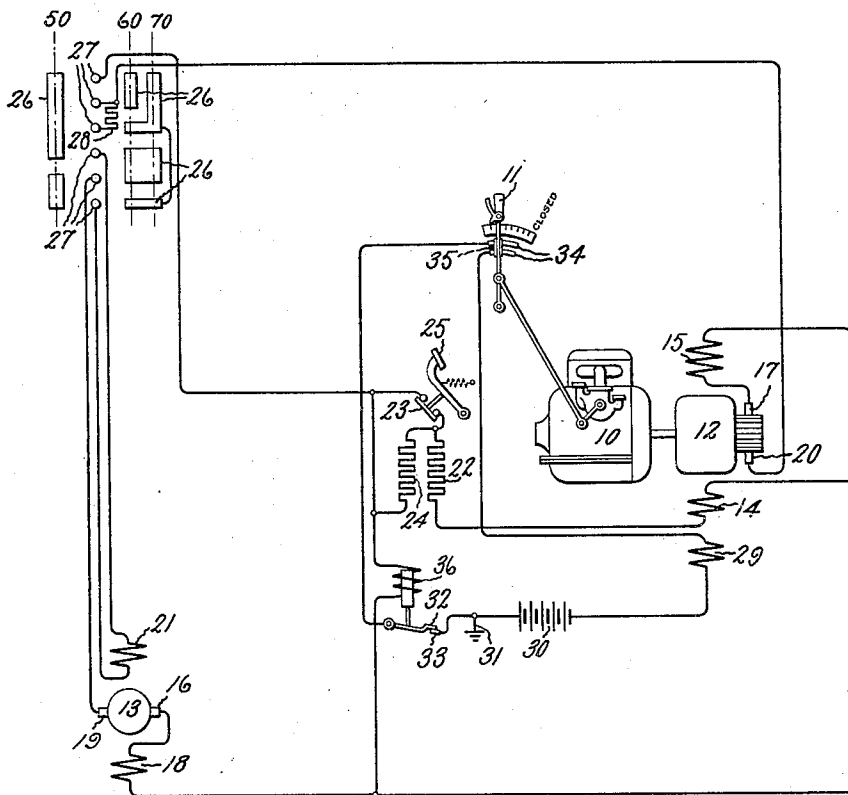
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ELECTRICALLY DRIVEN VEHICLE

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UNITED STATES PATENT OFFICE

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ELECTRICALLY-DRIVEN VEHICLE

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My invention relates to electrically driven vehicles of the type having an internal combustion engine or other prime mover arranged to drive a generator to which the driving motors of the vehicle are connected.

5 In operating vehicles of this kind, it is the practice to control them entirely by regulating the speed of the engine. When it is desired to bring the vehicle to a stop, the engine is slowed down to idling speed, and the brakes applied without disconnecting the driving 10 motors from the generator. This is permissible because the voltage of the generator at idling speed is so low that there is substantially no torque exerted by the driving 15 motors. In starting the vehicle the brakes are released and the engine speed increased which gradually raises the voltage of the generator to the normal value and causes the driving 20 motors to give the necessary starting torque. The generator in a vehicle of this kind, therefore, builds up its voltage slowly because of the load of the driving motors connected thereto and for this reason the vehicle is accelerated at a correspondingly slow rate as 25 the starting torque of the motors is dependent upon the voltage of the generator. In certain classes of service where it is desired to make frequent stops during a run, as for example, in passenger busses, this slow rate of 30 acceleration is a great disadvantage because it substantially decreases the average speed of the vehicle.

The object of my invention is to provide an 35 arrangement in an electric vehicle of this character which will considerably increase the rate of acceleration of the vehicle in starting, and thereby increase the average speed of the vehicle when it is being operated under 40 conditions requiring frequent stops. I accomplish this by providing an auxiliary winding associated with the excitation system of the generator which is energized during starting the vehicle by means independent 45 of the generator so as to increase the rate of building up of the voltage of the generator under the load of the driving motors and increase the rate of acceleration of the vehicle.

My invention will be more fully set forth in 50 the following description, referring to the ac-

companying drawing, and the features of novelty which characterize my invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

The single figure of the drawing diagrammatically illustrates the electrically driven vehicle embodying my invention.

Referring to the drawing, the vehicle in connection with which I have shown my invention comprises an internal combustion engine 10 having a throttle lever 11 or other suitable device for controlling the speed of the same and directly connected to the armature 12 of the generator to which the driving motor 13 of the vehicle is connected. The generator is provided with an excitation system including a shunt exciting field winding 14 and a series commutating exciting field winding 15. One brush 16 of the driving motor 13 is directly connected to the load brush 17 of the generator by a circuit including commutating exciting field winding 18 thereof and the commutating exciting field winding 15 of the generator. The other terminal 19 of the motor is arranged to be connected to the other load brush 20 of the generator through the exciting field winding 21 of the motor and the contacts of a controller. One terminal of the shunt winding 14 is connected to the load brush 17 of the generator and the other terminal thereof is connected to the load brush 20 by a circuit including the controller, a resistance 22 and normally closed switch 23. In order to provide for decreasing the excitation of the generator when it is heavily loaded a resistance 24 is connected across the switch 23 and a foot pedal 25 is arranged in the vehicle for opening the switch 23 to place this resistance in circuit with the winding 14. The controller for the vehicle is provided with a plurality of relatively movable contacts 26 and 27 arranged so that in position 50 the motor 13 is connected to the generator for forward operation, in position 55 60 the motor and generator are connected through a resistance 28 for braking, and in position 70 the driving motor is reversed.

In ordinary operation of the vehicle the driving motor 13 remains connected to the 100

armature 12 of the generator, and the vehicle is controlled entirely by controlling the speed of the engine 10. When it is desired to stop the vehicle, the throttle lever 11 of the engine is moved to close the throttle which decreases the speed of the engine and the voltage of the generator so that the driving motors 13 exert substantially no torque, and the brakes can be applied in the usual manner to bring the vehicle to rest. In starting the brakes are released and the lever 11 is moved to open the throttle which increases the speed of the engine 10, and the voltage applied to the driving motor by the generator. However, as the driving motor is connected directly across the terminals of the generator during the period that the vehicle is being accelerated, the generator, which is self-excited by the shunt field exciting winding 14, builds up its voltage quite slowly and accelerates the vehicle at a correspondingly slow rate. In accordance with my invention the rate of acceleration of the vehicle, when it is started under this condition is increased by providing an auxiliary winding 29, which is adapted to be energized by any suitable means independent of the generator during starting of the vehicle to increase the rate of building up of voltage of the generator and correspondingly increase the rate of acceleration of the vehicle. In the particular construction illustrated the auxiliary winding 29 is energized by a battery 30 having one terminal directly connected thereto and the other terminal, which is grounded at 31, connected thereto through contacts 32 and 33 of a relay and contacts 34 and 35 of a switch controlled by the throttle lever 11 or other controlling device of the engine.

It is desirable when the vehicle is stopped that this auxiliary winding should not be energized because the driving motor 13 remains connected to the armature 12 of the generator and its voltage at idling speed of the engine would be great enough to cause excessive short-circuit current through the motor. For this reason, I arrange the contacts 34 and 35 of the switch controlled by the throttle lever 11 so that the auxiliary winding 29 is energized in response to moving the throttle lever from closed toward open position, and so that the auxiliary winding is deenergized in response to moving the throttle lever from open toward closed position. In this way the auxiliary winding 29 will be energized during the period that the vehicle is being accelerated so as to increase its rate of acceleration, but will be deenergized when the throttle is closed in stopping the vehicle.

After the vehicle has reached normal running speed the auxiliary winding should be deenergized because this additional excitation increases the load on the generator, and thereby slows down the engine below the speed corresponding to its maximum power output.

The throttle is not entirely closed under this condition so that it is necessary to provide other means for deenergizing the auxiliary winding. I prefer to do this by means responsive to the electrical characteristics of the generator for opening the contacts 32 and 33. The arrangement which I have shown comprises a coil 36 of the relay including the contacts 32 and 33 which is connected across the generator field exciting winding 14 and the resistance 22 in circuit therewith. This relay is constructed so that the contacts 32 and 33 remain closed until the normal voltage of the generator at running speed of the vehicle is attained, and then the contact 32 is raised from contact 33 by the coil 36 which deenergizes the auxiliary winding 29.

In the operation of the vehicle which I have described, after the engine has started, the controller is moved to position 50 which connects the driving motor 13 directly to the generator 12. The lever 11 is then moved to open the throttle which increases the speed of the engine and, at the same time, closes the contacts 34 and 35 so as to energize the auxiliary winding 29 of the generator. This causes the voltage of the generator to build up rapidly, and the driving motor 13 to accelerate the vehicle at a correspondingly rapid rate. When the vehicle reaches normal running speed the contacts 32 and 33 of the relay are opened by the coil 36 which deenergizes the auxiliary winding 29 so that it will not interfere with the normal operation of the vehicle. Upon bringing the vehicle to a stop, the lever 11 is moved to close the throttle and to move the contact 35 out of engagement with the contacts 34 and open the circuit to the auxiliary winding 29 which will also be open at this time because the contact 32 will have been raised by the coil 36. As the vehicle is brought to rest the voltage of the generator will be reduced so that the coil 36 will be only slightly energized which will permit the contact 32 to drop into engagement with the contact 33. This will not, however, energize the auxiliary winding 29 because the contacts 34 will be opened by the previous movement of the lever 11 to close the throttle, so that when the vehicle is brought to rest heavy short-circuit current through the motor 13 is avoided without the necessity of disconnecting it from the generator.

In view of the foregoing it will be seen that I have produced a simple arrangement for increasing the acceleration of an electrically driven vehicle which will not interfere with its normal operation or overload the engine at idling speed when the vehicle is at rest.

Modifications of the construction disclosed herein will occur to those skilled in the art so that I do not desire to be limited to the particular arrangement shown and described except as defined in the appended claims.

What I claim as new and desire to secure

by Letters Patent of the United States, is:—

1. An electrically driven vehicle comprising an engine, a generator driven by said engine, a driving motor for said vehicle adapted to be connected to said generator, an excitation system for said generator energized by the same, an auxiliary winding associated with said excitation system, means for energizing said auxiliary winding during starting of said vehicle to facilitate building up of the voltage of said generator under load, and means connected across said generator and responsive to the normal voltage of said generator when said vehicle has reached running speed for deenergizing said auxiliary winding.

2. An electrically driven vehicle comprising an engine having a controlling device, a generator driven by said engine, a driving motor for said vehicle adapted to be connected to said generator, an excitation system for said generator energized by the same, an auxiliary winding associated with said excitation system, means controlled by said controlling device for energizing said auxiliary winding during starting of said vehicle so as to facilitate building up of the voltage of said generator under load, and means connected across said generator and responsive to the normal voltage of said generator when said vehicle has reached running speed for deenergizing said auxiliary winding.

3. An electrically driven vehicle comprising an engine having a device for controlling the same, a generator driven by said engine, a driving motor for said vehicle adapted to be connected to said generator, an excitation system for said generator energized by said armature, an auxiliary winding associated with said excitation system, means for energizing said auxiliary winding in response to moving said device to increase the speed of said engine so as to facilitate building up of the voltage of said generator under load during starting of said vehicle and for deenergizing said auxiliary winding in response to moving said device to decrease the speed of said engine, and means connected across said generator and responsive to the normal voltage of said generator when said vehicle has reached running speed for deenergizing said auxiliary winding.

4. An electrically driven vehicle comprising an engine having a device for controlling the same, a generator driven by said engine, a driving motor for said vehicle adapted to be connected to said generator, an excitation system for said generator energized by said armature, an auxiliary winding associated with said excitation system, means for energizing said auxiliary winding in response to moving said device to increase the speed of said engine above idling speed so as to facilitate building up of the voltage of said generator under load during starting of said

vehicle and for deenergizing said auxiliary winding in response to moving said device to decrease the speed of said engine below idling speed, said means including a battery connected to said auxiliary winding, and means including a relay connected across said generator responsive to the normal voltage of said generator when said vehicle has reached running speed for deenergizing said auxiliary winding.

In witness whereof, I have hereunto set my hand this 9th day of June, 1928.

WALTER C. HARRIS.