

R. H. BEACH.
SELF PROPELLED VEHICLE.
APPLICATION FILED SEPT. 15, 1914.

1,275,201.

Patented Aug. 13, 1918.
3 SHEETS—SHEET 1.

FIG 1.

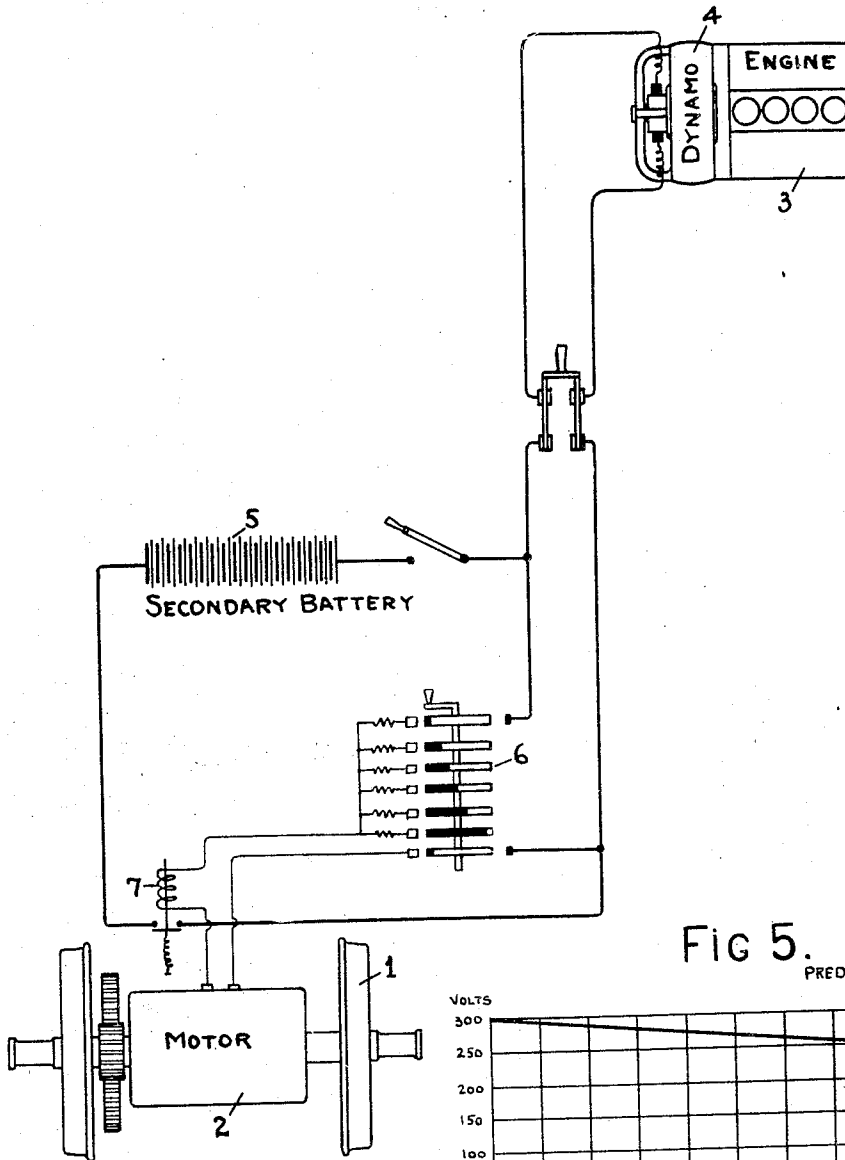
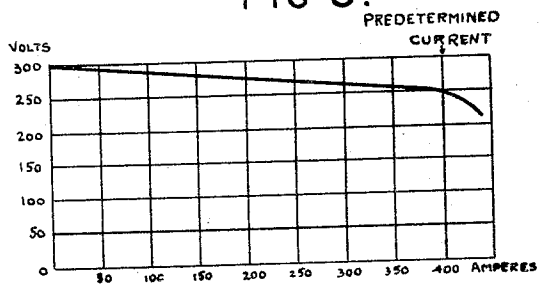


FIG 5.



WITNESSES:

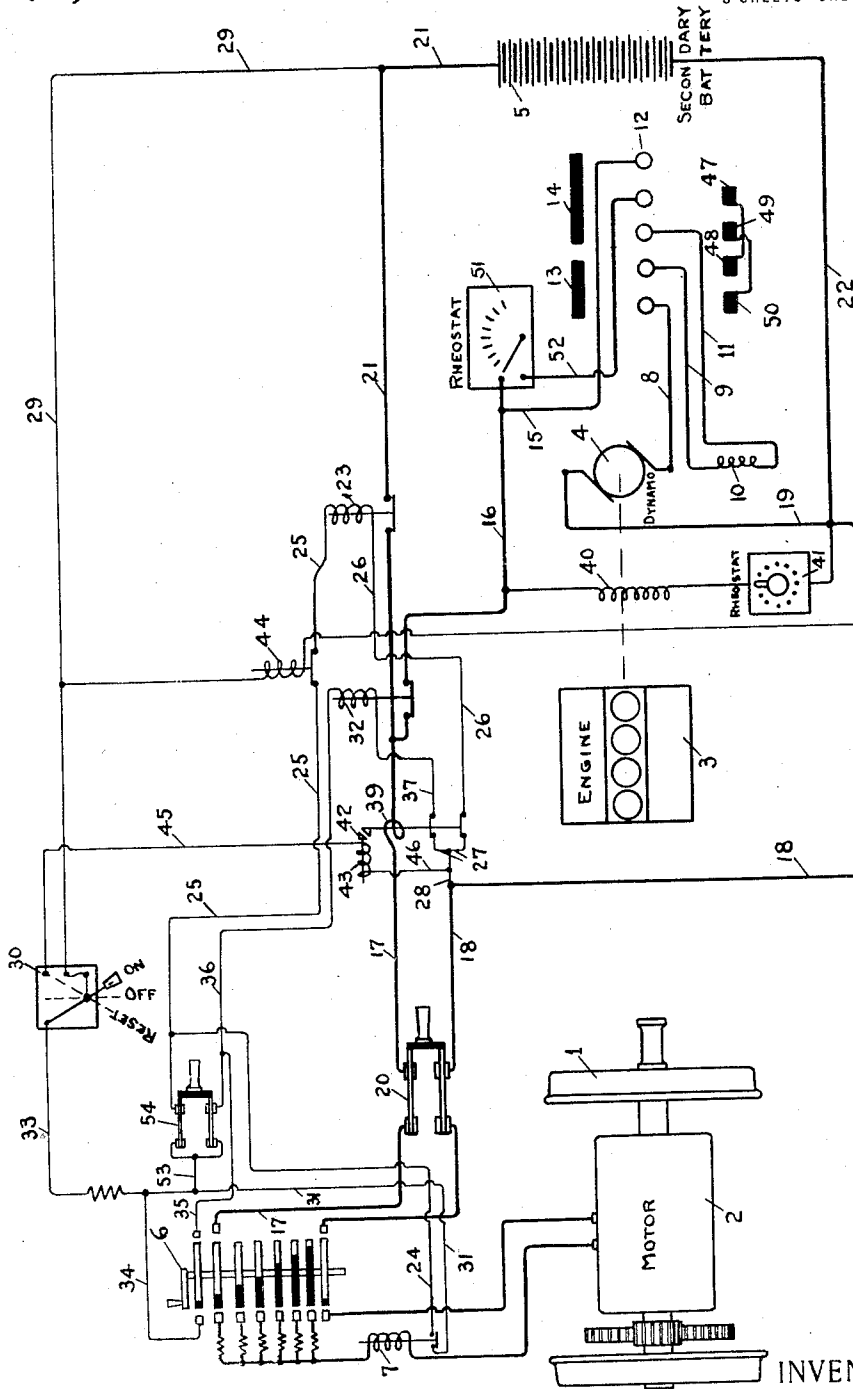
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FIG 2.



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Fig 4.

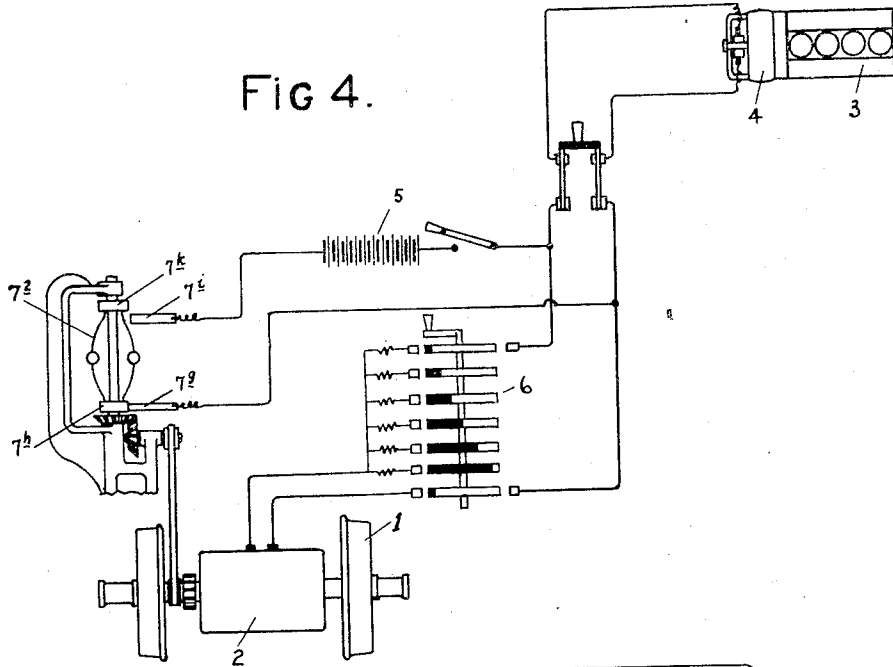
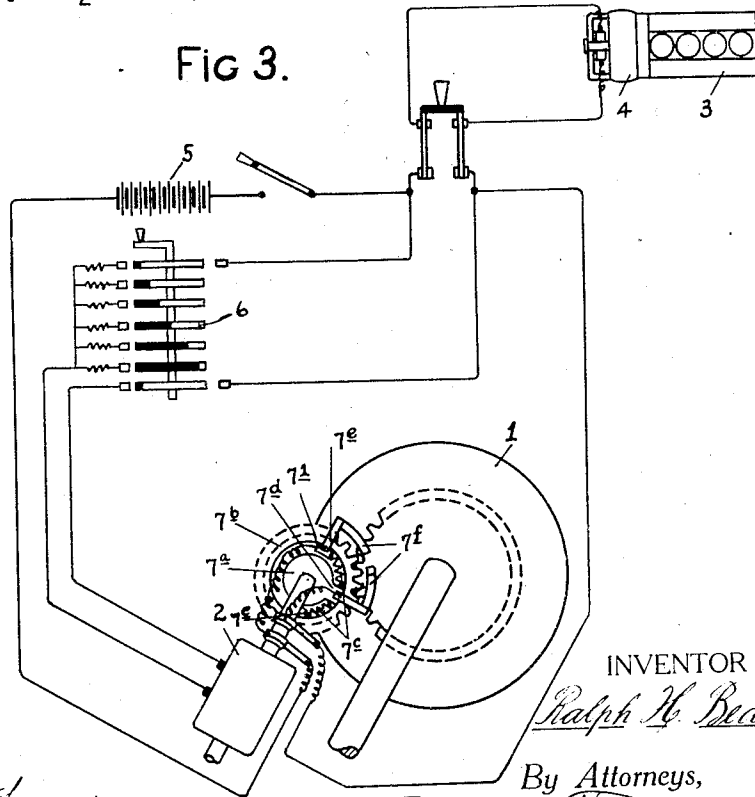


Fig 3.



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UNITED STATES PATENT OFFICE.

RALPH H. BEACH, OF NEW YORK, N. Y., ASSIGNOR TO MAUDE E. BEACH, OF NEW YORK, N. Y.

SELF-PROPELLED VEHICLE.

1,275,201.

Specification of Letters Patent.

Patented Aug. 13, 1918.

Application filed September 15, 1914. Serial No. 861,755.

To all whom it may concern:

Be it known that I, RALPH H. BEACH, a citizen of the United States of America, residing in the city of New York, county and State of New York, have invented certain new and useful Improvements in Self-Propelled Vehicles, of which the following is a specification.

This invention relates to self-propelled vehicles and aims to provide improvements therein.

It is desirable, and practically essential in most vehicles, and particularly road vehicles and railway cars, to obtain a relatively quickly accelerated start. As the mass, represented by the vehicle and load, is a fairly constant factor, it is evident that in order to develop speed or momentum rapidly a considerably greater force is required than is required to develop the same speed or momentum in a longer time. Variable resistances, such as are furnished by the air, the surface or medium on which the vehicle moves, and gravity on grades, are factors requiring a propelling force largely in excess of that required for maintaining a given speed under normal conditions. These conditions are met with in vehicles of practically all kinds, and the consequence has been that in self-propelled vehicles, in order to obtain a rapid acceleration, and overcome variable resistances, a source of energy largely in excess of that needed for maintaining a given speed, has been required. The size of the source of energy is a factor effecting the first cost thereof, the load, the free space in the vehicle, and the consumption of fuel. This is particularly so in the case of vehicles propelled by internal combustion engines. Engines of very much larger size are required than would be required for maintaining a given speed under normal conditions. Much valuable space is occupied and there is a large waste of fuel. A very practical consideration is that internal combustion engines of large size have not reached nearly the development and do not have nearly the efficiency of the smaller sizes of internal combustion engines, which latter in fact, have attained a relatively high development.

Secondary batteries have been used as a source of energy for self-propelled vehicles,

and, while these respond better than some other types of energy-sources to the requirement of quick acceleration and propulsion against variable resistance, they are objectionable because of the limited total energy which can be obtained therefrom, and because of the great weight, bulk and cost thereof and the recharging delays.

The present invention combines a prime-mover and a secondary battery in such manner that a vehicle is provided wherein the objections, inherent or existing in the use of either alone, are largely obviated, and wherein the energy of one may be made to augment that of the other at desired or necessary times.

The secondary battery, according to the present invention, is preferably arranged to operate, or be placed in multiple with the generator, only at such times as a current in excess of that of which the generator is capable of furnishing, or in excess of a predetermined current, is required for accelerating or driving the vehicle. The present invention further includes means whereby such coöperation of the secondary battery, for the furnishing of additional current, is automatically effected.

The invention further includes means for utilizing the secondary battery for starting the engine or prime-mover, such means being preferably in the general combination or system.

The invention further provides for the charging of the secondary battery by the generator.

The prime-mover is preferably an internal combustion engine.

When a prime mover, dynamo and secondary battery are combined as in the present invention a very much smaller prime-mover or engine may be employed than is necessary where a vehicle is propelled by a prime-mover or engine alone. The prime mover is preferably capable of delivering about sufficient force to maintain the vehicle at a constant predetermined velocity of speed under normal running conditions. Also much smaller secondary batteries are employed than is necessary when a vehicle, capable of moving any considerable distance in a day, is propelled by secondary batteries alone, the secondary battery being prefer-

ably of about sufficient size to deliver current for providing the desired accelerations, and, where desired, augmentations to the force of the prime-mover, regard being had to the opportunities for recharging. There is much saving in the size and cost of the prime-mover or engine; also in the size and cost of the storage battery; and the combined saving in first cost, cost of operation, efficiency, and space is very considerable over self-propelled vehicles at present in use. The saving of space in self-propelled vehicles is of very material importance, especially in passenger or freight-carrying vehicles.

Other features of the invention will be hereinafter pointed out.

Embodiments of the invention are diagrammatically illustrated in the accompanying drawings, wherein

Figure 1 illustrates a simple embodiment of the invention;

Fig. 2 illustrates a more developed embodiment of the invention;

Figs. 3 and 4 illustrate embodiments similar to that shown in Fig. 1, different forms of means for automatically controlling the co-action of the battery and generator being shown; and

Fig. 5 is a graph illustrating voltage and current characteristics for the dynamo which is preferably employed.

Referring to the drawings, numeral 1 designates the propelling means of a vehicle, as for instance the wheels of a railway car, 2 an electric motor suitably arranged and connected to drive said wheels or other propelling means, 3 a prime-mover or engine, as for instance an internal combustion engine, 4 an electric generator, preferably directly driven by said prime-mover and mounted upon the same base therewith, and 5 a secondary battery.

The engine or prime-mover 3 drives the generator 4 and is preferably of such power as to supply the necessary force to maintain the vehicle at a constant desired speed under normal conditions. The generator 4 is electrically connected to the motor and supplies current for energizing the motor. The supply of current to the motor may be controlled by a suitable controller 6.

The secondary battery 5 is preferably connected in multiple with the generator circuit for the purpose of supplying additional current, at desired times, to the motor 2, the connection preferably being such that the battery current, together with the generator current, may be under the control of the controller 6.

The life or duration of a secondary battery having been found to be adversely affected by the frequency of the reversals taking place therein, according to the present invention, the battery, when used in multiple

with the generator, is only placed in circuit when the current from the generator reaches its maximum or a predetermined limit, for the purpose of supplying additional current to the motor. When the current flowing to the motor falls below the generator maximum or the predetermined limit, the battery is cut out, and remains cut out until additional current is required therefrom by the motors.

The battery is only charged at intervals, according to will, and engineering considerations.

The coöperation of the secondary battery with the generator, as aforesaid, may be controlled either by hand or automatically—preferably automatically—as illustrated.

The automatic device may be a magnetic device 7 (Figs. 1 and 2), preferably located in the motor circuit, and acting at a certain current strength to effect the co-action of the battery and generator, preferably by closing a circuit which will place the battery in multiple with the generator. When the current strength falls below that at which the device 7 operates, the device 7 breaks the circuit and cuts out the battery.

Or, the automatic device may be a device 7¹ (Fig. 3) operating at a certain driving force or torque of the motor, or, a device 7² (Fig. 4) operating at a certain derivative of the driving force, as the speed of the motor.

In Fig. 3, the device 7¹ is shown as comprising a disk 7^a fixed on the motor shaft, and a driving pinion 7^b which is loose on the motor shaft. Force is applied to the driving pinion 7^b from the disk 7^a through springs 7^c bearing at the ends against abutments 7^d and 7^e on the disk 7^a and pinion 7^b respectively. 7^f are contacts. The springs 7^c may be so proportioned that when the torque or driving force of the motor reaches a certain or predetermined amount, the contacts 7^f come together and complete the battery circuit, here shown as in multiple with the generator, thereby providing an augmentation of the driving force. When the torque or driving force goes below said predetermined amount, said contacts 7^f move apart, and the circuit is broken, cutting out the secondary battery.

In Fig. 4, the device 7² is shown in the form of a "governor", which may be driven by a pulley on the car-wheel axle. 7^g is a brush adapted to contact with a contact ring 7^h on the governor. 7ⁱ is a second brush and 7^k is a second contact ring carried by the "governor". When the "governor" is at rest, the brush 7ⁱ is preferably out of contact with the ring 7^k. The initial motion of the governor however brings the brush 7ⁱ and ring 7^k into contact, completing the battery circuit, here shown as in multiple with the generator, augmenting the current flowing to the motor and consequently the driving

force. When the governor reaches a certain or predetermined speed the brush 7¹ and ring 7² move apart and break the battery circuit.

5 *Normal running.*—The running condition and operation of the embodiments illustrated in Figs. 1, 3 and 4 will be readily apparent from the foregoing description.

Referring now to Fig. 2, the secondary battery 5, as in Fig. 1, is preferably adapted to be connected in multiple with the generator circuit for the purpose of supplying additional current, at desired times, to the motor, the connection preferably being such that the battery current, together with the generator current may be under control of the controller 6.

The generator is connected to the controller 6 through the conductors 8 and 9, field 10, conductor 11, field reversing switch 12 (through contacts 13 and 14 thereof), and conductors 15, 16 and 17 on one side, and through conductors 18 and 19 on the other side. A main connecting switch 20 is preferably placed in the conductors 17 and 18.

The secondary battery 5 is adapted to be connected in multiple with the generator through the conductor 21, on one side, and conductor 22, on the other, the connection of the secondary battery 5 to the generator 4 being under the primary control of the current limit switch 7.

The current limit switch 7, as here illustrated, may act upon the secondary battery circuit through the intermediary of a switch 23, which is closed under the action of current, preferably from the secondary battery 5, through the following circuit: conductors 24 and 25, coil of switch 23 and conductors 26, 27, 28, 18 and 22 on one side, and conductors 21 and 29, control switch 30 (in the "on" position thereof) and conductors 33 and 31.

A switch 32 is also preferably placed in the generator circuit, the switch 32 being closed by current from the battery. Current may flow to the switch 32 over the following circuit: conductors 21 and 29, control switch 30, conductors 33 and 34, conductors 35 and 36, coil of switch 32 and conductors 37, 27, 28, 18 and 22. The circuit is closed through the controller 6, the contact 38 of which makes contact with the terminals of the conductors 34 and 35 at the first movement of the handle of the controller.

An overload cut-out 39, having its coil in the main circuit, is preferably provided, which acts upon the main circuit through the intermediary of the switch 32. Upon an overload occurring, the cut-out 39 operates to break the circuit of the switch 32, and the switch 32 thereupon operates to break the main circuit.

The generator 4 is preferably a compound wound dynamo. 40 designates the shunt

field thereof. The winding is preferably such that the voltage of the dynamo, which is normally greater than the battery voltage, rapidly falls when the current from the dynamo reaches its maximum, or the predetermined limit at which it is desired that the battery should cooperate. The voltage of the generator at this point may vary within a considerable range without any considerable variation in the generator current, whereby, when the battery and generator are connected in multiple, the generator voltage may vary over a considerable range in equalizing with the battery voltage, without involving any very considerable variation from the current limit at which it is desired that the battery shall augment the dynamo. An example of the dynamo voltage and current characteristics are represented by the curve in Fig. 5.

Inasmuch as the voltage of a secondary battery varies according to the amount of charge therein (being progressively lower according to the degree of discharge) it is desirable to regulate the voltage of the generator in accordance with that of the secondary battery. This is preferably accomplished by placing a rheostat 41 in the shunt field. By regulating the resistance in the shunt field, the voltage of the generator can be regulated to that of the battery.

The engine 3 being in operation, the vehicle is started by turning the controller 6 in the usual manner. The first movement of the controller handle closes the circuit from the secondary battery through the switch 32. The switch 32 operates to close the generator circuit at this point. Subsequent movements of the controller 6 admit current to the motor in the usual or any suitable manner. The motor (or motors) being still will take a large amount of current—more than can be furnished by the generator. The current limit switch 7 is thereupon operated, closing the circuit through the switch 23. The switch 23 closes the secondary battery circuit, and current flows to the motor from both the generator 4 and the secondary battery 5. A large force for rapid acceleration is thereby produced in the motor or motors. As the vehicle approaches normal speed the counter electromotive force of the motor will cut down the current from the battery and generator. When the predetermined current limit is reached the switch 7 will open the circuit of the switch 23, whereupon the switch 23 operates to cut out the battery.

An overload will cause the cut-out 39 to break the circuit of the switches 23 and 32, and thus cut out both the battery and generator.

The overload cut-out 39 is preferably of a type which is held open by a catch 42 when in open position. To reset the cut-out 39 after having acted, the catch 42 may be

withdrawn by the magnetic action of a coil 43. Current is admitted from the secondary battery to the coil 43 by moving the handle of the control switch 30 to reset position, via conductors 21, 29, 45, 46, 28, 18 and 22.

Engine starting.—The invention preferably provides for the starting of the engine 3 by running the generator 4 as a motor, current being furnished by the secondary battery 5.

The generator 4 being a compound wound dynamo, in order that the dynamo (when running as a motor) may turn in a direction to start the engine in the right direction, it will be desirable, and in most cases necessary, to reverse the series field 10. The reversal of the series field is effected by the field reversing switch 12, the switch 12 being turned so that a circuit is made through contacts 47, 48, 49 and 50. Current may then flow from the secondary battery 5 to the dynamo 4 (acting as a motor) over the conductors 21 and 16, the rheostat 51 (which is provided for regulating the admission of current to the dynamo now acting as a motor), conductor 52, contacts 47 and 48, conductor 9, field 10, conductor 11, contacts 49 and 50, conductor 8, and back to the battery through conductors 19 and 22.

For closing the switches 23 and 32, in starting the engine, a switch 54 is provided. Switch 54 admits current from the battery to the crils of the switches 23 and 32 over the conductors 21, 29, control switch 30, and conductors 33, 53, 25, 26, 36, 37, 27, 28, 18 and 22. The controller 6 and switch 20 are preferably open when starting the engine.

After the engine is started, the switch 54 is opened, breaking the circuits of the switches 23 and 32, which open the generator and battery circuits. Upon the falling of current, the rheostat 51 operates to break the circuit thereat. The field reversing switch 12 may then be turned to its first position (circuit closed through contacts 13 and 14), putting the generator in normal running condition.

Recharging the secondary battery.—To recharge the secondary battery by the generator 4, the circuit between the generator and battery is closed by the switches 23 and 32, switch 54 being closed to admit current from the battery to the coils of the said switches. The circuit is preferably broken at the switch 20 and the controller 6. The shunt field 40 of the generator is adjusted by means of the rheostat 41 until the voltage of the generator is adjusted to the charging voltage of the battery. When the charging has proceeded to the desired extent, the circuit between the generator and the secondary battery is broken at the switches 23 and 32 by opening the switch 54. Over-

pressure upon the battery is prevented by an over-voltage cut-out 44. The cut-out 44, upon over-pressure, breaks the circuit through the coil of the switch 23 and causes the switch 23 to cut-out the battery.

While I have shown and described several embodiments of the invention, the invention is not to be understood as limited thereto, as the invention may receive other expressions of the inventive idea.

What is claimed is:—

1. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator for supplying current to said driving means, means for driving said generator, a secondary battery, and automatic means for connecting said battery and generator to cooperate in driving said propeller.

2. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator for supplying current to said driving means, means for driving said generator, a secondary battery, and automatic electric means for connecting said battery and generator to cooperate in driving said propeller.

3. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator for supplying current to said driving means, means for driving said generator, a secondary battery, and means adapted to operate at a predetermined force value for connecting said battery and generator to cooperate in driving said propeller.

4. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator for supplying current to said motor, means for driving said generator, and means adapted to operate at a predetermined force value of the motor for connecting said battery and generator to cooperate in driving said propeller.

5. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator for supplying current to said motor, means for driving said generator, and a current controlled device in said motor circuit adapted to connect said secondary battery with said motor when the current flowing to said motor reaches a predetermined limit.

6. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator for supplying current to said motor, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, and a common controller for controlling the current from said battery and generator.

7. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator for supplying current to said motor, an internal combustion engine for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit.
8. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator for supplying current to said motor, means for driving said generator, a secondary battery, and means for connecting said battery and generator to cooperate in driving said propeller, said driving means being capable of delivering a driving force intermediate that required for producing rapid acceleration and that for maintaining the vehicle at a constant speed under normal running conditions.
9. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator, means for driving said generator, a secondary battery, and means for connecting said battery and generator to cooperate in driving said propeller, said secondary battery having a capacity intermediate that required for producing the required quick accelerations and that required for furnishing the complete driving force for the vehicle.
10. In a self-propelled vehicle, a propeller, an electric means for driving said propeller, an electric generator, means for driving said generator, a secondary battery, and means for connecting said battery and generator to cooperate in driving said propeller, said driving means being capable of delivering a driving force intermediate that required for producing rapid acceleration and that for maintaining the vehicle at a constant speed under normal running conditions, said secondary battery having a capacity intermediate that required for producing the required quick accelerations and that required for furnishing the complete driving force for the vehicle.
11. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said driving means being capable of delivering a driving force intermediate that required for producing rapid acceleration and that for maintaining the vehicle at a constant speed under normal running conditions.
12. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said driving means being capable of delivering a driving force intermediate that required for producing rapid acceleration and that for maintaining the vehicle at a constant speed under normal running conditions.
13. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said driving means being capable of delivering a driving force intermediate that required for producing rapid acceleration and that for maintaining the vehicle at a constant speed under normal running conditions, said secondary battery having a capacity intermediate that required for producing the required quick accelerations and that required for furnishing the complete driving force for the vehicle.
14. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said driving means being capable of delivering a maximum driving force substantially equaling that required to maintain the vehicle at a constant speed under normal running conditions.
15. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said generator having a regulatable field.
16. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said generator being a compound-wound dynamo having a regulatable shunt field.
17. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said generator having a voltage which rapidly falls at a certain current strength.
18. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller,

a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the
5 motor reaches a predetermined limit, said generator having a voltage which rapidly falls at its normal current maximum.

19. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller,
10 a secondary battery, an electric generator, means for driving said generator, and means for connecting said secondary battery with said motor when the driving force of the
15 motor reaches a predetermined limit, said generator having a voltage which rapidly falls at said predetermined current limit at which said connecting means is adapted to operate.

20. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, an internal combustion engine for driving said generator, and means for connecting
25 said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said generator having a shunt-field and a series field, means for reversing one of said fields, and means for connecting said battery to said generator with

reversed field, whereby the generator may
30 be run as a motor to start said engine.

21. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator, means for driving said generator, and means
35 for connecting said secondary battery with said motor when the driving force of the motor reaches a predetermined limit, said generator having a regulatable field, and means for connecting said generator and battery,
40 whereby said battery may be charged by said generator.

22. In a self-propelled vehicle, a propeller, an electric motor for driving said propeller, a secondary battery, an electric generator,
45 means for driving said generator, a cut-out between said battery and motor, and a device adapted to actuate said cut-out to close the circuit between said secondary battery and motor upon the driving force of said
50 motor reaching a predetermined limit.

In witness whereof, I have hereunto signed my name in the presence of two subscribing witnesses.

RALPH H. BEACH.

Witnesses:

GUSTAVE R. THOMPSON,
FRED WHITE.