Feb. 3, 1925. 1,525,129

J. A. HEANY

DYNAMO ELECTRIC STARTING, LIGHTING, AND IGNITION MECHANISM FOR AUTOMOBILES

Original Filed Aug. 1, 1910 2 Sheets-Sheet 1

Fig. I.

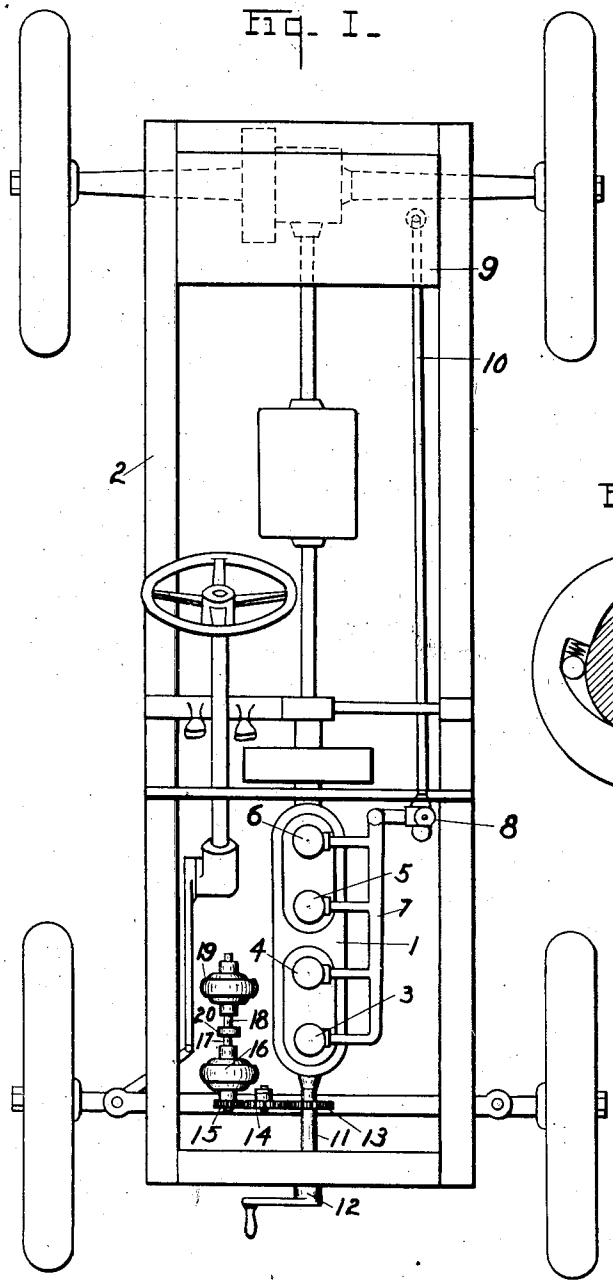
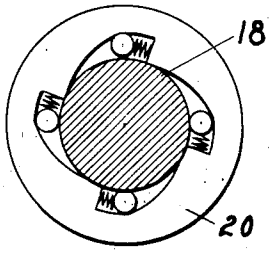


Fig. IV.



Inventor
John Allen Heany

By Hayner H. Gordon

Attorney

Feb. 3, 1925. 1,525,129

J. A. HEANY

DYNAMO ELECTRIC STARTING, LIGHTING, AND IGNITION MECHANISM FOR AUTOMOBILES

Original Filed Aug. 1, 1910 2 Sheets-Sheet 2

Fig. II.

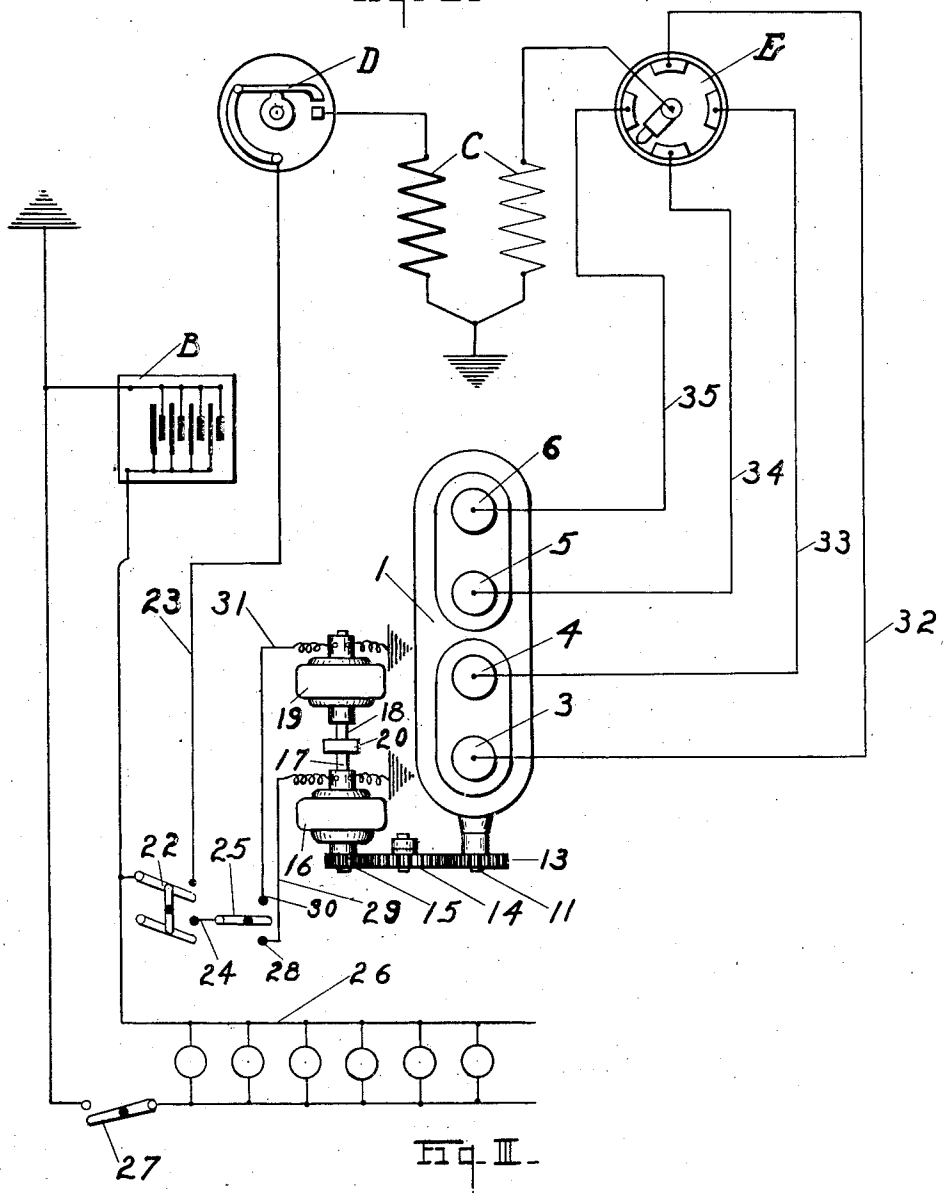
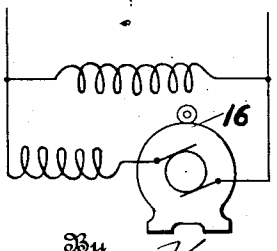


Fig. III.



Inventor

John Allen Heany

By Haynes N. Gordon

Attorney

Patented Feb. 3, 1925. 1,525,129

UNITED STATES PATENT OFFICE.

JOHN ALLEN HEANY, OF JERSEY CITY, NEW JERSEY, ASSIGNOR, BY MESNE ASSIGNMENTS, TO INDUSTRIAL RESEARCH CORPORATION, A CORPORATION OF DELAWARE.

DYNAMO-ELECTRIC STARTING, LIGHTING, AND IGNITION MECHANISM FOR AUTOMOBILES.

Original application filed August 1, 1910, Serial No. 574,774. Divided and this application filed November 3, 1917. Serial No. 200,095.

To all whom it may concern:

Be it known that I, JOHN ALLEN HEANY, a citizen of the United States, and a resident of Jersey City, in the county of Hudson and State of New Jersey, have invented certain new and useful Improvements in Dynamo-Electric Starting, Lighting, and Ignition Mechanism for Automobiles, of which the following is a full, clear, and exact description, whereby anyone skilled in the art may make and use the same.

This invention relates to means for translating electrical energy into motive power for starting an engine and means for translating the motive power of the engine into electrical energy for the starting mechanism and the lighting and ignition system to be used in conjunction with an automobile. This application is a division of my co-pending application, Serial No. 574,774, filed August 1st, 1910.

The principal object of the invention is to provide a motor starting element for an internal combustion engine and a generating element independent of the starting element, the generator and motor elements being so disposed with reference to the engine and to each other that greater economy of space consistent with the necessary mechanical and electrical efficiency of the system is secured.

It is a further object of the present invention to provide electrical equipment for internal combustion engines in which the motor starting elements and generating elements are associated together in a more or less unitary form of structure which renders the same readily adaptable to various forms of engines and provides for accessibility when it is desirous to make repairs and to provide a system in which the arrangement of the motor and generator elements tends to reduce current and voltage fluctuations to a minimum in the various circuits during the starting operation.

Thus the invention contemplates such a unitary arrangement of mechanism having separate motor armature and generator windings and co-operating field windings arranged whereby, during starting, the motor windings operate when energized from the battery to supply the turning moment or necessary torque with the generator windings, commutator, and correlated parts revolving therewith forming a fly-wheel effect having certain advantageous advantages as will hereinafter appear.

Further objects, and objects relating to economies of manufacture and details of construction will definitely appear from the detailed description to follow.

I accomplish the objects of my invention by the devices described in the following specification. My invention is clearly defined and pointed out in the appended claims.

A structure constituting a preferred embodiment of my invention is illustrated in the accompanying drawing, forming a part of this specification, in which:

Fig. I illustrates my invention embodied in an automobile, the storage battery not being shown.

Fig. II is a diagrammatical view of the various parts comprising the system illustrating the interconnection between the various elements.

Fig. III is a diagrammatic view illustrating the differentially wound generator.

Fig. IV illustrates a form of clutch which may be used to connect the motor shaft to the generator shaft.

In automobile construction it is particularly desirable, in view of the necessary limitations in space and weight, to design and dispose the various parts that so far as possible unnecessary duplication is avoided. It is also desirable that, in obtaining this economy of space and weight, in a starting and lighting system, the electrical efficiency of the system shall be maintained. In the mechanism hereafter described it is proposed to utilize the shaft of the generator armature, not only as a bearing for the generator armature, but also as a power-transmitting means for the motor when starting the engine, thereby permitting the employment of but one set of gearing between the engine shaft and the electrical units if desired, or producing a combined starting and generating structure in which the rotative generator elements may be caused to revolve

with the motor windings during starting to form in effect, an inertia or fly-wheel element facilitating starting.

As illustrated in the drawings, the engine 1 is shown as mounted upon the chassis frame 2, and provided with cylinders 3, 4, 5 and 6, which receive their fuel supply in any well-known manner as through the manifold 7, and carburetor 8, the fuel being supplied from the main tank 9, through a connecting tube 10.

The engine shaft 11 is shown as projecting forward and terminating in a starting crank 12, which, of course, may be used for initially starting the engine to charge the battery hereinafter described.

Upon the shaft of the engine is a gear 13, meshing with an intermediate gear 14, which in turn is in mesh with the generator gear 15, these gears being so arranged as to drive the generator 16, as the engine shaft is rotated.

On the end of the generator, opposite to the gear 15, the generator shaft 17 is interconnected with the shaft 18 of the starting motor 19, by means of a clutch device 20, the shafts 18 and 19 thus forming a rotatable central supporting means upon which the respective motor and generator elements are mounted. The generator armature, windings, commutator, and other correlated parts thereof in the system disclosed herein are thus made to revolve with the central supporting means when the motor windings are energized for starting. The clutch 20 is of a form designed to make operative connection when the motor is the driver, the over-running clutch shown in Fig. IV being a common form, and is adapted to transmit torque from the motor to the engine and not to transmit torque from the engine to the motor.

B denotes a storage battery which, through a switch 22, connects said battery to the ignition line circuit 23, and to a motor and generator line-circuit 24, which latter is controlled by a switch 25. A movement of the switch 25, to the contact point 28 connects the generating circuit 29, of the generator 16, with the storage battery whenever the switch 22 is closed. A movement of the switch 25, to the contact member 30, connects the circuit 31, of the motor 19, with the storage battery whenever the switch 22 is in closed position.

A load circuit, shown herein as the lighting circuit, as indicated at 26, is controlled by a switch 27.

Any desired form of ignition may be employed, as for instance, the induction coil, high tension, or low tension types in common use. A diagrammatic showing of the ignition system is illustrated in Fig. II, where the make and break D, is connected in the circuit 23, to the coil C, and thence to a distributor E, the stationary contacts of which are connected to the insulated terminals of the spark plugs of the engine cylinders through circuit wires 32, 33, 34, 35.

The generator 16 is preferably a machine adapted to give a partically constant voltage when used in connection with the battery, throughout the varying speeds characteristic of the internal combustion engine. The particular type of generator here employed is shown in Fig. III as a differentially wound compound machine, the reversed series winding compensating for variation of voltage due to speed variations, when connected to the storage battery. The storage battery, consisting of a low resistance load with increase in current through the series field winding caused by increase in speed of the generator, will tend to weaken the magnetic flux set up by the shunt field and therefore with properly proportioned windings and voltage in the system will remain approximately constant irrespective of speed variations when the generator is connected to the battery.

It is preferred to use a series-wound motor 19, with a low resistance winding, which is adapted to give a large starting torque with high wattage, and as it is geared to the engine shaft through a reducing speed gear train, it will readily give the initial movement to said shaft for securing the compression and firing to start the engine. When the motor 19 is thus driving, the clutch device 20, illustrated more in detail in Fig. V, will connect the motor shaft for positively driving the train of gears.

As soon as the engine has been started and runs beyond the speed of the motor 19, the clutch device will slip and the motion of the engine shaft will not be transmitted to the shaft of the motor 19. The function of the clutch 20 is to provide a connection between the generator shaft 17 and the motor shaft 18 which will transmit torque from the motor to the engine and will not transmit torque from the engine to the motor.

As is apparent from the drawings, the motor shaft is in axial alinement with the generator shaft so that the same gear set may be employed by both motor and generator. This arrangement also permits the disposition of the electrical units in parallel and close proximity with the engine thereby securing great economy in space,—a feature very desirable in automobile construction. During the starting operation, the internal combustion engine imposes upon the starting motor a load of fluctuating character, the peaks of which correspond to the compression in the engine. In the present combination, the generator armature and windings are so arranged relative to the motor armature and its windings, that the same rotate at the same speed therewith and act as a

motor fly-wheel acquiring momentum during the interval when the entire power of the motor is not consumed in rotating the engine shaft, and therefore serving to an extent to supplement the power developed by the motor at the points of maximum compression in the engine. The action of the generator armature and windings which thus function as an inertia member, tend to decrease the effect of the strain upon the gearing connections between the motor and engine, and at the same time tend to even the fluctuations of the current demand upon the battery, which is of special advantage in its effect upon the ignition system in which the demand for current exists at the time of greatest cylinder compression in the engine and consequent greatest current demand by the starting motor. A similar beneficial result is also obtained in the lighting system when the same is connected to the battery during the starting operation, the inertia member co-operating with the lighting circuit in the manner already set forth to minimize flickering of the lamps.

In ordinary operation, the switch 22 is closed, connecting the line 24, and the ignition line 23. Thereupon, the switch 25 is first thrown to connect the terminal 30, and motor-line 31. Thus a circuit from the battery to the motor field and armature windings is established without supplying energy to the generator armature windings. As soon as the engine has started the switch 25 is thrown to the contact 28, and connects the generator 16 with the storage battery circuit so that said battery is recharged by the generator 16. Thus means are provided under the control of the operator for shifting the circuit from the battery to the motor armature and field windings to effect an establishment of the proper charging circuits between the generator windings and the battery.

It is, of course, apparent that the switch devices might be automatically controlled from the motor and generator shafts so that the switching of the battery circuit from the motor to the generating circuit could be accomplished automatically. The motor circuit being thus broken by the operator or automatically and the overrunning clutch 20 providing a slip when the engine speed assumes normal operation, it will thus be seen that the motor windings are disabled when the engine operates under its own power. Similarly, the details of connections intermediate the dynamo, the motor and the engine shaft as well as those of the controlling switches or devices may be varied to suit the exigencies of any particular case, it being most desirable to provide connections which will give a proper ratio for starting the engine from the motor and a suitable ratio between the engine and the dynamo shaft with manually-operated or automatically operated switching devices for giving the proper circuit connections between said devices and the source of power.

I am aware that this particular embodiment of my invention is susceptible of considerable variation without departing from the spirit of my invention, and, therefore, I desire to claim the same broadly, as well as specifically, as indicated by the appended claims.

Having thus described my invention, what I claim as new and desire to secure by Letters Patent, is:

1. The combination with a variable speed engine; of an electric starting and generating plant therefor, comprising a generator; an armature, and armature shaft for said generator; a storage battery; a starting motor independent of the generator and adapted to start the engine through the armature shaft of the generator; circuits and switches for connecting the battery to the generator and to the motor; connections between the generator and engine; and automatic means for disconnecting the motor when the engine operates under its own power.

2. The combination with a variable speed engine; of an electric starting and generating plant therefor, comprising a generator; an armature, and armature shaft for the generator; connections between the generator and engine; a storage battery; a starting motor independent of said generator; connections intermediate said starting motor and generator, whereby said starting motor starts the engine through the armature shaft of said generator and said engine and generator connections; circuits and switches for connecting the battery to the generator and to the motor; and automatic means for disconnecting said connections between the motor and generator when the engine operates under its own power.

3. The combination with a variable speed engine; of an electric starting and generating plant therefor, comprising a generator having an armature, and armature shaft connected to said engine; a storage battery; a starting motor independent of said generator; connections, including a clutch, intermediate said starting motor and generator whereby said starting motor starts the engine through the armature shaft of said generator and connections, the clutch being inactive when the engine operates the generator under its own power; and circuits and switches for connecting the battery to the generator and to the motor independently.

4. The combination with a variable speed engine; of an electric starting and generating plant therefor, comprising a generator connected to said engine; a storage battery;

a starting motor independent of the generator and having its armature shaft in axial alignment with the armature shaft of the generator; means connecting said armature shafts whereby the starting motor operates to start the engine through the generator armature shaft, the motor being disconnected when the engine operates under its own power; and circuits and switches for connecting the battery to the generator and to the motor.

5. The combination with a variable speed engine having ignition means; of an electric starting and generating plant therefor, comprising a storage battery; a generator, including an armature and shaft, having constant operative connection with the engine; a motor independent of the generator; connections between the motor and generator whereby the motor starts the engine through the generator shaft, said connections being rendered inoperative when the generator speed exceeds that of the motor; and circuits and switches for connecting the battery to the generator and to the motor.

6. The combination with a variable speed engine having ignition means; of an electric starting and generating plant therefor, comprising a storage battery; a generator, including an armature and shaft having constant operative connection with the engine; a motor independent of the generator; connections between the motor and generator whereby the motor starts the engine through the generator shaft, said connections being adapted to transmit torque only from the motor to the generator; and circuits and switches for connecting the battery to the generator and to the motor.

7. The combination with a variable speed engine; of an electric starting and generating plant therefor, comprising a generator connected to said engine; a storage battery; a starting motor independent of the generator and having its armature shaft in axial alignment with the armature shaft of the generator; means including a clutch connecting said armature shafts whereby the starting motor operates to start the engine through the generator armature shaft, said connecting means being adapted to transmit torque from the motor to the generator only; and circuits and switches for connecting the battery to the generator and to the motor.

8. The combination with a variable speed engine; of an electric starting and generating system therefor, comprising a generator; driving connections between said generator and said engine; a storage battery; a starting motor independent of the generator; driving connections between said motor and said engine, including the driving connections between said generator and the engine and adapted to transmit torque from the motor to the engine but not in the reverse direction; and circuits and switches for connecting the battery to the generator and to the motor.

9. The combination with a variable speed engine, of an electrical system comprising an ignition means, a starting motor, a battery and circuits associated therewith adapted to supply electric energy simultaneously to said ignition means and starting motor, an electric generator having constant driving connection with the engine and adapted to charge said battery when the engine is running, said generator and starting motor having their shafts in axial alignment, and connecting means between said shafts whereby the motor starts the engine through the generator shaft, the generator armature acting as an inertia element.

10. The combination with an internal combustion engine of an electrical starting and generating system including a unitary combined starting and generating electrical mechanism having rotatable central supporting means carrying a motor armature winding and a separate generator armature winding arranged to rotate at the same angular velocity during starting, field windings adapted to cooperate with said armature windings, a storage battery, circuit and controlling means adapted to connect said battery to the motor field winding and only the motor of said armature windings during the transmission of rotational torque to the engine and between the generator windings of said electrical mechanism and said battery adapted to permit charging of said battery therefrom, torque transmitting means between said engine and said generator armature windings whereby the latter may be operated from the former to charge said battery, said central supporting means having means to transmit torque developed by said motor windings to said engine adapted to prevent the transmission of torque from the engine to the motor armature windings therethrough.

11. The combination with an internal combustion engine of an electrical starting and generating system including a unitary combined starting and generating electrical mechanism having rotatable central supporting means carrying a motor armature winding and a separate generator armature winding arranged to rotate at the same angular velocity during starting, field windings adapted to cooperate with said armature windings, the field windings cooperating with the motor armature windings being in series therewith, a storage battery, circuit and controlling means adapted to connect said battery to the motor field wind-

ings and only the motor of said armature windings during the transmission of rotational torque to the engine, driving torque transmitting means between said engine and said generator armature windings whereby the latter may be operated from the former to charge said battery, said central supporting means having starting torque transmitting means and circuit and circuit controlling means between the generator windings of said electrical mechanism and said battery adapted to permit charging of said battery therefrom.

12. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the crank shaft of the engine, a motor, and connections between the motor and generator adapted to transmit torque through the generator in a direction only from the motor to the generator to start the engine.

13. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, means mounted upon said armature shaft adapted for permanent driving connection with the crank shaft of an engine, a motor, and connections, including a clutch, between the motor and generator adapted to transmit torque through the generator in a direction only from the motor to the generator to start the engine.

14. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the engine, a motor, and a clutch mechanism intermediate the motor and generator, adapted to establish a positive driving connection from the motor to the generator and through the generator to the engine when the motor speed exceeds that of the generator.

15. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the crank shaft of the engine, a motor, and connections between the motor and generator, operative when the speed of the motor shaft exceeds that of the generator, whereby torque is transmitted through the generator from the motor to start the engine.

16. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the crank shaft of the engine, a motor having an armature, a shaft for said motor armature, said motor shaft being in axial alignment with the generator shaft, and connections intermediate the generator and motor shafts whereby torque may be transmitted in a direction only from the motor to the generator.

17. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the crank shaft of the engine, a motor having an armature, a shaft for said motor armature, said motor shaft being in axial alignment with the generator shaft, and driving connections intermediate the generator and motor shafts operative only when the motor shaft speed exceeds that of the generator shaft.

18. In combination with the crank shaft of an internal combustion engine, an electric generator having an armature, a shaft for said armature, a permanent driving connection between said armature shaft and the crank shaft of the engine, a motor, a shaft for said motor, said shaft serving as a continuation for the armature shaft of the generator and as part of the driving connections between the motor and the engine crank shaft to start the engine.

19. The combination with an internal combustion engine, of an electric generator, a motor, a driving connection between said generator and said engine, and a driving connection between said motor and said generator, whereby torque is transmitted through the generator from the motor to start the engine when the same is energized.

20. The combination with an internal combustion engine, of an electric generator, a motor, a driving connection between the generator and the engine, and a driving connection between the motor and the generator, including a clutch, whereby torque is transmitted through the generator only in the direction from the motor to start the engine.

21. The combination with an internal combustion engine of an electrical starting and generating system including a unitary combined starting and generating electrical mechanism having rotatable central supporting means carrying a motor armature winding and a separate generator armature winding arranged to rotate at the same angular velocity during starting, field windings adapted to cooperate with said armature windings, a storage battery, circuit and controlling means adapted to connect said battery to the motor field winding and only the motor of said armature windings for starting, and between the generator windings of said electrical mechanism and said battery adapted to permit charging of said battery therefrom, torque transmitting means between said engine and said generator armature windings whereby the latter

may be operated from the former to charge said battery, said central supporting means having means to transmit torque developed by said motor windings to said engine adapted to prevent the transmission of torque from the engine to the motor armature windings therethrough.

22. The combination with an internal combustion engine of an electrical starting and generating system including a unitary combined starting and generating electrical mechanism having rotatable, central supporting means carrying a motor armature winding and a separate generator armature winding arranged to rotate at the same angular velocity at starting, field windings adapated to cooperate with said armature windings, a storage battery, a circuit adapted to connect said battery to the motor field windings and only the motor of said armature windings for starting, a circuit between the generator windings of said electrical mechanism and said battery adapted to permit charging of said battery therefrom, means to establish said starting circuit and means controlled by the operator to shift from said starting circuit to permit establishment of said charging circuit, torque transmission means between the engine and said electrical mechanism adapted to start said engine and drive said generator armature windings, said central supporting means having mechanical means to transmit the torque of said motor armature windings to said engine to start the latter, said mechanical power transmitting means to the engine from said electrical mechanism constructed to automatically permit said engine to overrun said motor armature windings when the engine starts.

23. The combination with an internal combustion engine of an electrical starting and generating system including a unitary combined starting and generating electrical mechanism having rotatable central supporting means carrying a motor armature winding and a separate generator armature winding arranged to rotate at the same angular velocity during starting, field windings adapted to cooperate with said armature windings the field windings cooperating with the motor armature windings being in series therewith, a storage battery, circuit and controlling means adapted to connect said battery to the motor field windings and only the motor of said armature windings for starting, driving torque transmitting means between said engine and said generator armature windings whereby the latter may be operated from the former to charge said battery, said central supporting means having starting torque transmitting means, circuit and circuit controlling means between the generator windings of said electrical mechanism and said battery adapted to permit charging of said battery therefrom.

In witness whereof, I affix my signature.

JOHN ALLEN HEANY.