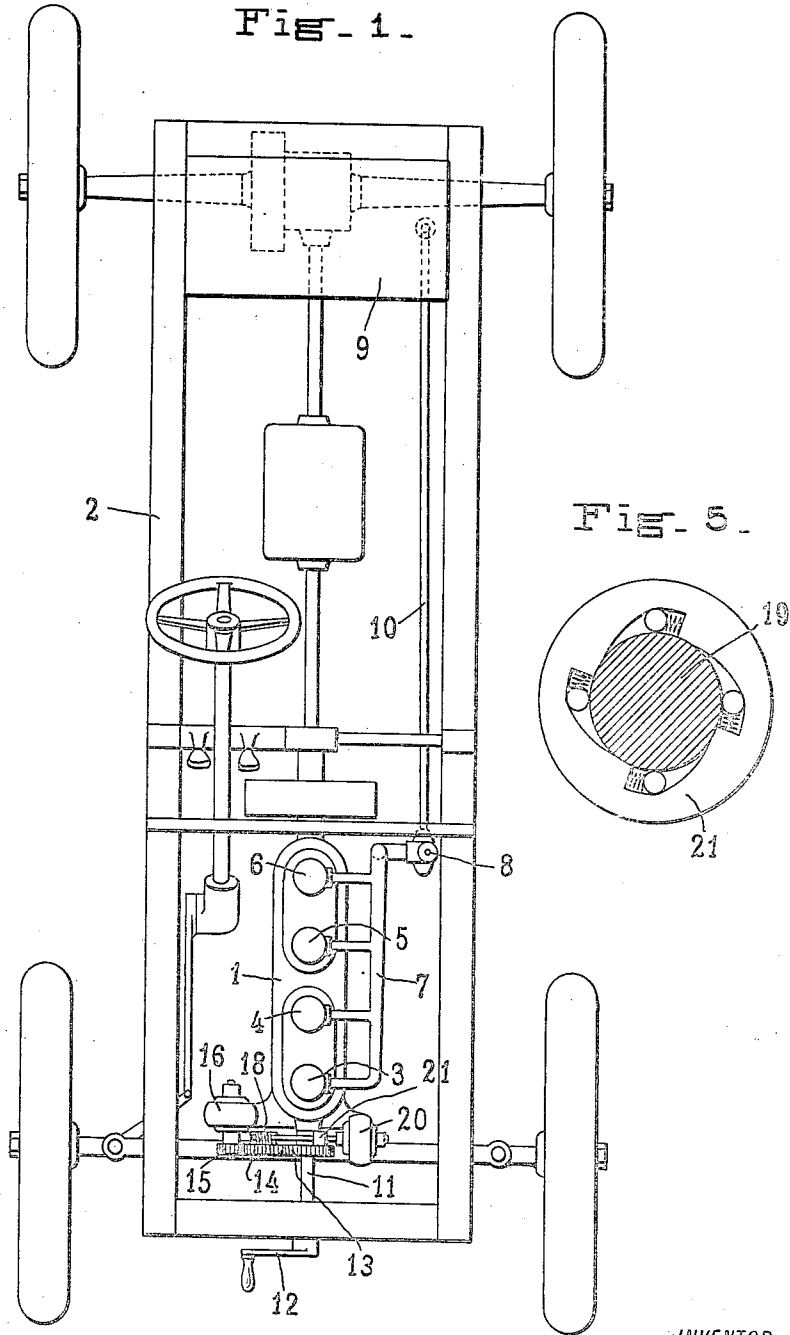


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 DYNAMO ELECTRIC STARTING, LIGHTING, AND IGNITION MECHANISM FOR AUTOMOBILES.
 APPLICATION FILED AUG. 1, 1910.

1,287,989.

Patented Dec. 17, 1918.
 2 SHEETS—SHEET 1.



WITNESSES

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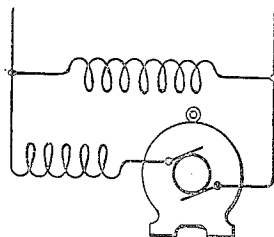
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DYNAMO-ELECTRIC STARTING, LIGHTING, AND IGNITION MECHANISM FOR AUTOMOBILES.

1,287,989.

Specification of Letters Patent.

Patented Dec. 17, 1918.

Application filed August 1, 1910. Serial No. 574,774.

To all whom it may concern:

Be it known that I, JOHN ALLEN HEANY, a citizen of the United States, and a resident of Flint, in the county of Genesee and State of Michigan, 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 any one skilled in the art may make and use the same.

The invention relates to a device for furnishing a suitable means for translating electrical energy for starting an engine and a further electrical means for furnishing electrical energy for the starting mechanism and the lighting and ignition system to be used in conjunction with an automobile.

The object of the invention is to provide a starting element which may be readily actuated by the operator, which starting element will give the initial movement to the engine and will not be affected by the speed thereof, and a generating element interconnected therewith to be operated by the engine after it is started, said generating element to furnish electrical energy of a substantially constant pressure for ignition and lighting purposes, as well as a maintenance of the supply for the starting element.

The objects of the invention are secured by utilizing a dynamo electric machine or motor geared or otherwise connected with the shaft of an internal combustion engine and a differentially wound electric generator driven from the shaft of the internal combustion engine in conjunction with a storage battery and suitable controlling devices.

Referring to the drawings:

Figure 1 illustrates the arrangement applied to the engine of an automobile, the storage battery not being shown.

Fig. 2 is a diagrammatic view, the various parts comprising the system illustrating the interconnection between the various elements.

Fig. 3 is a diagrammatic view illustrating the differentially wound generator.

Fig. 4 illustrates a slightly modified form of the device wherein the starting element and generating element are mounted in tandem.

Fig. 5 illustrates a form of clutch which may be used in the connections of the starting element and generating element.

To provide a suitable starting and generating device in connection with an internal combustion engine of variable speed, it is apparent that some difficulty is experienced in securing a dynamo electric machine of a convenient size which will have sufficient power in conjunction with a storage battery of small size to actuate the engine shaft and give the engine its initial movement. It is also apparent that with such a dynamo electric machine when used as a generator and driven from the engine shaft that there will be fluctuations in the electro-motive force. In fact, the electro-motive force in ordinary generators used for this class of work increases nearly in direct proportion with the speed. The result is that at low speeds, the electro-motive force of a generator is less than that of the battery and the latter discharges through the armature. When run at high speeds, the electro-motive force of the generator rises to such an extent as to cause a heavy flow of current through the storage battery and other devices over-charging it and breaking down its plates. Heretofore, to eliminate these discharges, various forms of friction clutches, mechanical and electric cut-outs have been arranged in conjunction with the dynamo electric machine for maintaining constant current conditions.

In the devices hereinafter described, it is proposed to utilize a generator which will give such a substantially constant electro-motive force throughout the various speeds induced by the engine directly geared thereto, that the battery, ignition apparatus, lamps or any other current translating devices included in the system will not be subjected to any injurious effects. This condition is secured by utilizing a series field-winding in addition to the shunt-field-winding, producing a series field excitation which is opposed to that of the shunt-winding and designed to be always less than the latter. In other words, the generator is differentially wound and as the speed increases and the electro-motive force increases, there will be an increase in the current passed through the ar-

mature and series winding, thus materially increasing the series field excitation opposed to the excitation of the shunt field and consequently decreasing the resultant field. In-
 5 as much as the electro-motive force of the generator is proportional to the product of the armature speed and the field strength, it is apparent that increase in speed tending to increase the electro-motive force produces a
 10 decrease in field strength and thus equalizes and maintains a substantially constant electro-motive force.

The best conditions in this type of regulation are obtained by making the shunt excitation equal to or less than the value of the break in the magnetization curve of the field core material. By doing this the resultant excitation ranging from lower values to this as a maximum will produce a field strength
 15 which is directly proportional to the excitation as between these values the magnetization curve is practically a straight line. Therefore, by selecting the proper proportional values of the shunt and series windings, the generator may be designed to maintain a substantially constant electro-motive force.

This present application is limited to a system embodying a combination of elements
 20 for the production of electrical energy from mechanical means and the use of such electrical energy for starting an internal combustion engine, the generation of electrical energy as herein described for use in connection with internal combustion engines forming the subject matter of my copending application, filed July 27, 1910, Serial No. 574,030, and the details of the starting element and the connections between the same
 25 and engine forming the subject matter of my divisional application Serial No. 262,701, filed November 15, 1918.

As illustrated in the drawings, the engine 1, is shown as mounted upon the chassis
 30 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 carbureter 8, the fuel being supplied from the main tank 9, through a connecting
 35 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
 40 battery hereinafter defined.

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

On the rear face of the gear 14, is shown a worm-gear 17, in mesh with a worm 18, upon the motor-shaft 19, which is connected to the motor 20, through a clutch device 21.

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

A movement of the switch 25, to the contact point 28, connects the generating circuit 29, of the generator 16, with the storage
 70 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 20, with the storage battery whenever the switch 22, is in closed position.

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. 2, where the
 80 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
 85 through circuit wires 32, 33, 34, 35.

It is preferred to use a series-wound motor 20, in order to give the greater starting torque and as it is geared to the crank shaft through the worm 18, worm-gear 17, and
 90 gears 14, 13, it will readily give the initial movement to said shaft for securing the compression and firing of the cylinders to start the engine. When the motor 20, is thus driving, the clutch device 21, illustrated more in
 95 detail in Fig. 5, 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 20, the clutch device will slip and the motion of the
 100 engine shaft will not be transmitted to the shaft of the motor 20.

In Fig. 4, there is illustrated a slightly modified form of the device in which the generator 40, has its shaft 41, arranged in
 105 continuation of the shaft 42, of the motor 43, with a clutch device 44, interposed in the connections. Gears 45, 46, and 47, connect the generator shaft with the engine shaft 48. In this modification which forms the subject
 110 matter of my divisional applications Serial No. 200,093 and Serial No. 200,095, filed November 3, 1917, the motor 43, turns the gears for starting the engine, the clutch 44, being operative to connect the engine shaft
 115 42, and the generator shaft 41. As soon as the engine has attained a considerable speed the clutch 44, will disconnect the engine shaft 42, and the generator shaft will then be run at a comparatively high speed, while
 120 the motor shaft remains at rest.

Of course, to secure these conditions, the controlling switches must be properly actuated.

In ordinary operation, the switch 22, is 130

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. As soon as the engine has started the switch 25, is moved from contact 30, thereby electrically deenergizing or disabling the motor, to the contact 28, and connects the generator 16, with the storage battery circuit so that said battery is recharged by the generator 16.

By arranging suitable electrical connections and switches, the generator may, at the starting operation, be used as a motor in conjunction with the motor 20, a system embodying such operation forming the subject matter of my divisional application Serial No. 200,092, filed November 3, 1917. 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. Such automatic control forms the subject matter of my divisional application Serial No. 262,702, filed November 15, 1918.

Applicant reserves the right to claim any inventions disclosed in the present application but not claimed herein, in separate applications.

Obviously, 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.

The particular embodiment of my invention herein disclosed is, of course, susceptible to considerable variation without departing from the spirit thereof, and it is to be understood that many changes might be made by those skilled in the art within the scope of the invention as defined in the appended claims.

What I declare as my invention 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 storage battery, a generator adapted to give a substantially constant voltage when connected thereto, a starting motor independent of the generator, circuits and switches whereby the generator may be connected to the battery independently of the starting motor, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from 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 storage battery, a differentially wound generator adapted to give a substantially constant voltage when connected thereto, a motor independent of the generator, circuits and switches for connecting the battery to the generator or to the motor independently, gearing connecting the generator to the engine, relatively low speed gearing connecting the motor to the engine, and automatic means for disconnecting the motor from the engine when the latter operates under its own power.

3. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery connected thereto, a motor independent of the generator, circuits and switches whereby the generator may be connected to the battery independently of the motor, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from the motor when the engine operates under its own power.

4. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery, a starting motor independent of the generator, circuits and switches for connecting the battery to the generator or to the motor independently, gearing connecting the generator to the engine, relatively low speed gearing connecting the motor to the engine, and automatic means for disconnecting the motor from the engine when the latter operates under its own power.

5. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery connected thereto, a starting motor independent of the generator, circuits and switch connections between the motor, generator and battery, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from the motor when the engine operates under its own power.

6. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery connected thereto, a starting motor independent of the generator, circuits and switch connections between the motor, generator and battery, connections from the motor and the generator to the shaft of the engine, and means for disabling the motor when the engine operates under its own power.

7. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a genera-

tor, a storage battery, a starting motor independent of the generator, circuits and switch connections between the motor, generator and battery, gearing connecting the generator to the engine, relatively low speed gearing connecting the motor to the engine, and automatic means for disconnecting the motor from the engine when the latter operates under its own power.

8. In a device of the character described, the combination with an engine, of a storage battery; electrical power transmitting devices, comprising a starting motor and a generator independent of the starting motor, interposed between the engine and battery to translate the electric power of the battery into mechanical power to start the engine and to translate the mechanical power of the running engine into electrical current for storage back into the common battery; two sets of gearing connecting the said electrical devices and said engine, one set for cranking the engine at high leverage and the second for driving by the engine for charging; and two separate circuit connections between said electrical devices and the battery, having provisions associated with the first for taking high wattage current from the battery to crank the engine through said high leverage gearing, and with the second circuit for delivering low wattage current to charge the battery by using said second set of gearing.

9. In a system of the character described, the combination with an internal combustion engine, of a lighting system therefor including lamps adapted for relatively low voltage current; a storage battery connected with said lighting system; electrical connections connected with said battery; a high leverage gearing connected with said engine; a lower leverage gearing connected with said engine; means including electrical power transmitting devices comprising a starting motor and a generator independent of the motor and connected with said gearing and said electrical battery connections for translating relatively high wattage current from said battery into mechanical power applied to said engine through the high ratio gearing to start the engine, and for translating power derived from the engine through the lower ratio gearing to the generator to charge said storage battery with current of lower wattage and of substantially the same voltage as that of the lighting system.

10. In a device of the character described, the combination with an engine, of a storage battery; electrical power transmitting devices comprising a starting motor and a generator independent of the motor interposed between the engine and battery to translate the electric power of the battery

into mechanical power to start the engine and to translate the mechanical power of the running engine into electrical current for storage back into the common battery; two sets of gearing connecting the said electrical devices and said engine, one set for cranking the engine at high leverage and the second for driving the generator by the engine for charging; and two separate circuit connections between said electrical devices and the battery, having provisions associated with the first for taking high wattage current from the battery to crank the motor through said high leverage gearing, and with the second circuit for delivering low wattage current to charge the battery by using said second set of gearing, and means for disconnecting the motor from the engine when the engine operates under its own power.

11. In a system of the character described, the combination with an internal combustion engine, of a lighting system therefor including lamps adapted for relatively low voltage current; a storage battery connected with said lighting system; electrical connections connected with said battery; a high leverage gearing connected with said engine; a lower leverage gearing connected with said engine; means including electrical power transmitting devices comprising a motor and a generator independent of the motor and connected with said gearing and said electrical battery connections for translating relatively high wattage current from said battery into mechanical power applied to said engine through the high ratio gearing to start the engine, and for translating power derived from the engine through the lower ratio gearing, to charge said storage battery with current of lower wattage and of substantially the same voltage as that of the lighting system, and means for disconnecting the motor when the engine operates under its own power.

12. In combination with an engine, of an electric plant embodying a motor for starting the engine, a generator, a storage battery, circuits and controlling devices for operating the motor from the battery and for storing the current from the generator in the battery, gearing connecting the generator to the shaft of the engine and the motor to the shaft of the engine, part of said gearing being common to both the motor and generator, and means for disconnecting the motor from the engine shaft when the engine operates under its own power.

13. In combination with an engine, of an electric plant embodying a starting motor, a generator, a storage battery, circuits and controlling devices for operating the motor from the battery and for storing the current from the generator in the battery, gearing

connecting the generator to the engine, and relatively low speed gearing connecting the motor to the engine, part of said gearings being common to both the generator and the motor.

14. In combination with an engine, of an electric plant embodying a starting motor, a generator, a storage battery, circuits and controlling devices, operating the motor from the battery and for storing the current from the generator in the battery, gearing connecting the generator to the engine, and relatively low speed gearing connecting the motor to the engine, part of said gearings being common to both the generator and the motor, and means for disconnecting the motor from the engine when the engine operates under its own power.

15. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery connected thereto, a starting motor independent of the generator, circuits and switch connections between the motor, generator and battery, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from the motor when the engine operates under its own power, the generator being constantly connected to the engine.

16. An electric starting and generating system adapted for connection with an internal combustion engine and comprising in combination a generator, a storage battery connected thereto, a starting motor independent of the generator, circuits and switch connections between the motor, generator and battery, connections from the motor and the generator to the shaft of the engine, and means for disabling the motor when the engine operates under its own power, the generator being constantly connected to the engine.

17. The combination with a variable speed internal combustion engine, of an electric starting and generating system therefor comprising a load circuit including a storage battery and ignition system, a generator including a rotor the speed of which varies with the speed of the engine, and field exciting means connected to inherently regulate the excitation to maintain an approximately constant voltage in said load circuit independent of the speed changes of the rotor when the generator is connected thereto, a starting motor independent of the generator, circuits and switches whereby the generator may be connected to the battery independently of the starting motor, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from the motor when the engine operates under its own power.

18. The combination with a variable speed internal combustion engine, of an electric starting and generating system therefor comprising a load circuit including a storage battery and ignition system, a generator having a rotor the speed of which varies with the speed of the engine, and means for automatically maintaining an approximately constant voltage in said load circuit independently of the speed changes of the rotor when said generator is delivering current thereto, a starting motor independent of the generator, circuits and switches whereby the generator may be connected to the battery independently of the starting motor, connections from the motor and the generator to the shaft of the engine, and means for disconnecting the engine from the motor when the engine operates under its own power.

19. The combination with a variable speed engine, of an electric starting and generating plant therefor, comprising a generator, a storage battery connected thereto, a motor independent of the generator, circuits and switches whereby the generator may be connected to the battery independently of the motor, connections from the motor and generator to the shaft of the engine, and means including an over-running clutch for disconnecting the engine from the motor when the engine operates under its own power.

20. In an appliance of the character described, in combination with a crank shaft of an internal combustion engine, an electric generator, a rotor shaft for said generator, transmission means permanently connecting said rotor shaft with the crank shaft of the internal combustion engine, a motor, means driven by the motor adapted to actuate an element of said transmission means and including a clutch mechanism designed to establish a driving relation between the motor and transmission means to start the engine and disconnect said driving relation upon the engine operating under its own power.

21. In combination with a crank shaft of an internal combustion engine, an electrical generator, a rotor shaft for said generator, transmission means permanently connecting said rotor shaft with the crank shaft of the internal combustion engine and including a secondary shaft and a train of gears between the secondary shaft and the crank shaft of the engine, a motor and means including a clutch mechanism intermediate the motor and secondary shaft designed to transmit torque in a direction only from the motor through the secondary shaft and train of gears to the engine crank shaft to start the engine.

22. In combination with a crank shaft of an internal combustion engine, an electric generator, a rotor shaft for said generator,

transmission means including a train of gears intermediate the rotor shaft and engine shaft for permanently connecting the rotor shaft with the engine shaft, a motor, 5 a second train of gears driven by the motor adapted to actuate the first mentioned train of gears, a clutch mechanism forming a part of the second gear train designed to establish a driving relation between the motor 10 and engine crank shaft to start the engine through both the trains of gearing and to disestablish said driving relation when the engine operates under its own power.

23. In combination with an internal combustion engine, an electric generator, permanent driving connections between the engine and generator, a motor independent of the generator, driving connections between the motor and an element of said permanent 20 driving connections adapted to transmit torque in a direction only from the motor to the engine to start the engine whereby the said motor driving connections are disconnected when the engine operates under 25 its own power.

24. In combination with an internal combustion engine, an electric generator, driving connections including a gear train between the engine and generator, a motor independent of the generator, driving connections between the motor and an element of said first named driving connections adapted to transmit torque in a direction only from the motor to the engine, whereby said 30 motor driving connections are disconnected when the engine operates under its own power, the connections between the motor

and engine having a higher torque ratio than the connections between the engine and generator. 40

25. The combination with the crank shaft of an internal combustion engine of an electric generator, a rotor shaft for said generator, transmission means forming a driving connection between said rotor shaft and said 45 engine shaft, a motor, driving connections between said motor and an element of said transmission means including a train of gearing and a clutch adapted to establish a driving relation between the motor and 50 engine crank shaft to start the engine and to disestablish said driving relation when the engine operates under its own power.

26. The combination with a crank shaft of an internal combustion engine of an electric 55 generator, transmission means between said generator and said engine crank shaft, a motor, and driving connections between said motor and an element of said transmission means, said driving connections including a 60 clutch adapted to transmit torque only in the direction from the motor to the engine.

27. The combination with an internal combustion engine, of an electric generator, transmission means between said engine and 65 said generator, a motor and torque multiplying driving connections between said motor and an element of said transmission means adapted to transmit torque only in the direction from the motor to the engine. 70

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Witnesses:

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