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STARTING DEVICE FOR INTERNAL COMBUSTION ENGINES.

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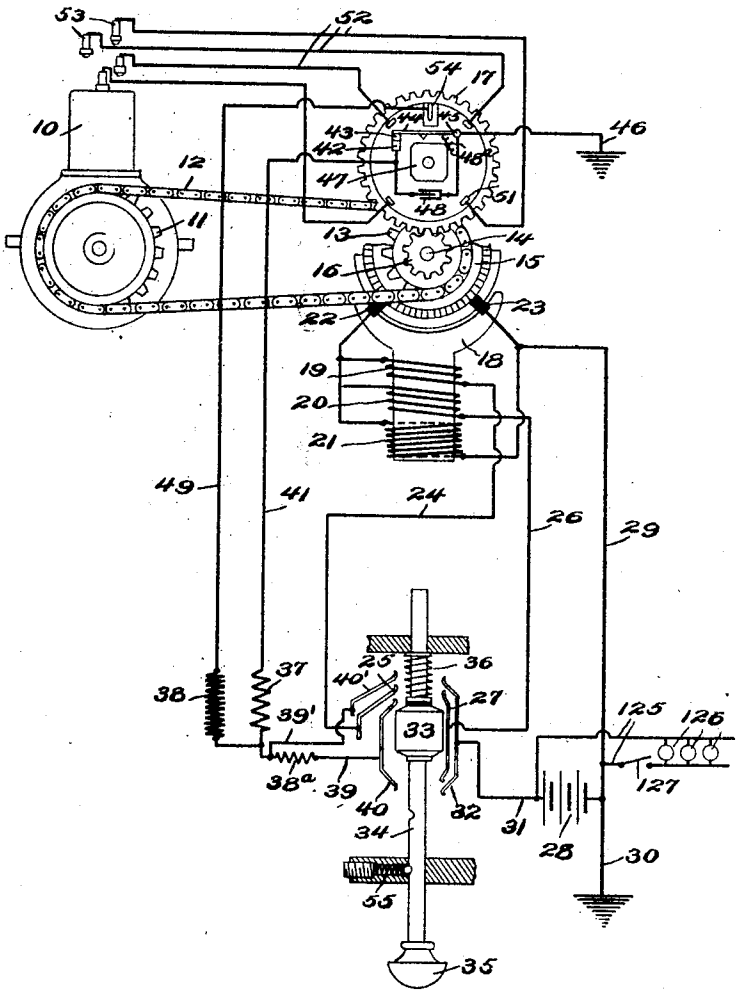
1,337,887. **Patented Apr. 20, 1920.**



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STARTING DEVICE FOR INTERNAL-COMBUSTION ENGINES.

1,337,887. Specification of Letters Patent. Patented Apr. 20, 1920.

Original application filed April 17, 1915, Serial No. 22,085. Divided and this application filed December 9, 1916. Serial No. 136,115.

To all whom it may concern:

Be it known that I, JAMES K. DELANO, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Starting Devices for Internal-Combustion Engines; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to starting devices for internal combustion engines; and it comprises more particularly an electrical cranking and ignition system useful in connection with gasolene or other internal combustion engines in automobiles and other motor vehicles.

The invention has to do chiefly with that class of power systems in which an internal combustion engine is employed to propel the running gear of a motor vehicle, and in which a dynamo electric machine is arranged for connection to the shaft of the internal combustion engine in such manner as to be operable either as a motor for the purpose of initially revolving the engine shaft to start or crank the engine, or as a generator driven from the engine shaft after starting for the purpose of storing up electrical energy in a storage battery or the like, such stored up energy being thereafter available for operating the dynamo electric machine as a motor to start the internal combustion engine, and for supplying current to an ignition system and, optionally, to a lighting system.

A system of this general character is described in my prior application Serial No. 22,085, filed April 17, 1915, and the present application, which is a division of said prior application, relates more particularly to the arrangement and operation of the ignition system in conjunction with the other parts of the system. Briefly described, the invention hereinafter claimed comprises an arrangement in which provision is made for permitting an increased flow of current through the ignition circuit while the engine is being started.

In order to clearly explain the principles underlying the invention, an especially advantageous form thereof is illustrated in the accompanying drawing, which represents diagrammatically the circuit relations of the various parts of a system embodying the invention hereinafter claimed.

Referring to said drawing, 10 is a conventional representation of an internal combustion engine of any suitable type, geared as by sprocket 11, chain 12, and sprocket 13, to the armature shaft 14 of a dynamo motor whose armature is indicated at 15. The armature shaft also carries pinion 16 meshing with a revoluble distributer gear 17. The poles of the dynamo motor, of which one is indicated at 18, are provided with three separate windings 19, 20, and 21. Winding 19 consists of a few turns of heavy wire and constitutes a series winding. 20 is another series winding consisting of a greater number of turns than winding 19, but wound in the same direction. The two series windings are operated in parallel when the electric machine runs as a motor in starting. Winding 19 is cut out of circuit when the machine operates as a generator, the resistance of the series field windings being therefore increased. 21 is a shunt winding, connected across brushes 22 and 23, its direction of winding being opposite to series field windings 19 and 20 when the machine is generating. Lead 24 connects series winding 19 to switch contact 25; while lead 26 connects series winding 20 to switch contact 27.

At 28 is indicated a storage battery which supplies electrical energy for operating the electric machine as a motor when starting the engine, and which receives energy from the electric machine when the latter is driven by the engine as a generator. The battery is connected on one side by lead 29 to brush 23 of the dynamo motor, and to ground as at 30; while lead 31 connects the other side of the battery to switch contact 32.

Means are provided for controlling electrical connections of the storage battery to the dynamo motor. Such means comprise in this instance a switch member 33 mounted upon but insulated from a longitudinally shiftable rod or shaft 34, which is here shown in its neutral position, that is, in such position as to entirely disconnect the battery from the dynamo motor. By pushing on knob 35 the switch member 33 may be moved against the resistance of spring 36 so as to make a bridging connection between switch contacts 27 and 32 on the one

hand, and contacts 32, 25, and 40′ on the other, this being known as starting position. In this position of the switch, current flows from the battery through lead 31, contact 32, switch member 33, contact 27, lead 26, series field winding 20, to brush 22, through the armature to brush 23, and thence through lead 29 to the other side of the battery. Current also flows from the battery through contact 32, switch member 33, contact 25, lead 24, series field winding 19, to brush 22, and thence through the armature to the other side of the battery, as before, the two series fields being therefore connected in multiple. It will be seen that current also flows from the battery through shunt winding 21, the effect of this current obviously being to reinforce the field and to coöperate with the current in the series field windings in producing a strong starting torque.

Upon release of the knob 35, the switch is always returned to neutral or inoperative position by spring 36, the spring being now idle and neither under compression or tension. When the engine has speeded up and is driving the dynamo motor as a generator, the switch is moved quickly into "running position" by pulling on the knob 35, manually or otherwise. In this latter position of the switch, the battery and dynamo motor are connected only through contacts 27 and 32. It will be seen also that series field winding 19 has been cut out, thus increasing the resistance of the series windings which were connected in multiple while starting, and that current flowing in the battery circuit from brushes 22 and 23 travels through series winding 20 in a direction opposite to that in which it flows through shunt winding 21. By means of this arrangement a differential effect is produced on the field when the machine operates as a generator, and development of excessive charging voltage across the battery terminals at high speeds is prevented.

The storage battery and dynamo motor are also utilized to supply power to an ignition system comprising a transformer and distributing and interrupting mechanism, suitably connected thereto. 37 represents the primary, and 38 the secondary, of a high tension transformer connected through a resistance 38ª and lead 39 to switch contact 40, operatively associated with switch member 33 before described. The transformer is also connected directly through lead 39′ to switch contact 40′. The transformer primary 37 is connected through lead 41 to coöperating contacts 42 and 43, contact 43 being carried by a movable conductive arm 44 pivoted at 45 and connected to ground at 46. Cam 47 is arranged to revolve in conjunction with distributing gear 17, periodically lifting arm 44 to separate contacts 42 and 43, and thus to interrupt the current in the primary ignition circuit. A condenser 48 is shown as bridged across said contacts. The spring 48ª, or the like, normally holds arm 44 down with contacts 42 and 43 in engagement.

The transformer secondary 38 is connected through lead 49 to a stationary contact ring (not shown); while the stationary contacts 51 are connected by leads 52 to the spark plugs 53 of the engine which, in the present example, is assumed to be a four cylinder engine. The brush 54, carried by but insulated from the revoluble distributing gear 17, is arranged to connect contacts 51 successively to the aforesaid contact ring as the gear revolves, thus supplying current in proper sequence to the spark plugs of the engine cylinders, the spark being properly timed by the interrupting mechanism above described.

Assuming switch member 33 to have been pushed into "starting position," it is apparent that the switch connects the battery with the ignition system through contact 40, lead 39, and resistance 38ª. It is evident that in this position of the switch the resistance 38ª is shunted, current passing through contact 40′ and lead 39′ directly to the transformer. The advantages of this are apparent; for at the moment of starting, the voltage drop in the storage battery is considerable; and if the battery happens to be partly discharged, the starting pull of current may not leave enough voltage to force current through both the resistance 38ª and the transformer primary in sufficient quantity to produce sparks of the proper intensity at the ignition plugs. By bridging or shunting the resistance in the manner described, the transformer primary receives sufficient current even though the battery voltage be materially below its normal value. Otherwise stated, the effect is to increase the ampere turns of the primary when the dynamo electric machine is connected to the battery for operation as a motor to start the engine. After the engine is running normally, and the switch 33 has been moved into running position, it is apparent that current must flow through resistance 38ª on its way to the ignition circuit, the resistance being provided to prevent excessive flow of current when cam 47 is revolving at low speed. The current interruptions at high speed serve to keep the current within the limits of the transformer and to prevent development of too much heat, which must be guarded against on account of the usual dust and water proof construction of the transformer coils, which allows very little ventilation.

In the specific arrangement shown in the drawing, the switch member 33 is arranged to be moved into starting position by a push

against knob or pedal 35, which may be conveniently located on the dash board where the system is employed in a motor vehicle. As here shown, the switch is automatically returned by spring 36 from starting position to neutral position as soon as knob 35 is released; and a spring stop 55 is arranged to engage a notch in the rod 34 to yieldably hold the switch in neutral position. By pulling on knob 35 the switch may be moved into running position, the stop 55 now engaging another notch on the switch rod to hold the switch in running position.

When the switch is moved into intermediate or neutral position, both the ignition system and the dynamo motor are disconnected from the battery, as stated, and the engine will come to a stop if it has been previously operating. No current can now flow back into the dynamo motor circuit, the described arrangement doing away with the automatic reverse current cut out commonly employed in starting systems heretofore proposed.

It is to be understood that, while a specific type of dynamo motor and also special switch means have been described for purposes of illustration, the invention is not limited thereto but is of general application, within the scope of the appended claim.

What I claim is:

In an electrical system for use with internal combustion engines, the combination, with a dynamo motor whose armature shaft is adapted to drive or to be driven by an internal combustion engine, and a storage battery arranged to supply current to said dynamo motor when the latter operates as a motor, and to be charged from said dynamo motor when the latter is driven as a generator, of an ignition system for such engine arranged to take current from said battery, a resistance disposed between the battery and the ignition system, a shunt around said resistance, and control means whereby the circuit connections between said battery, ignition system and dynamo motor may be varied according to whether the engine is being started, is running normally, or is at rest, said control means comprising a longitudinally reciprocable conductive switch member movable into "starting" and "running" positions, corresponding to the opposite extremes of its travel, and into "off" position intermediate such extremes, a plurality of double contact members so arranged that, in both starting and running positions of said switch member, said battery is connected to said ignition system through said resistance and also to said dynamo motor, and another contact member whereby, when said switch member is in starting position, the battery is also connected to said ignition system through said shunt, said switch member, when in its intermediate or "off" position, engaging none of said contact members.

In testimony whereof I hereunto affix my signature.

JAMES K. DELANO.