May 1, 1934. A. E. DOMAN 1,957,393

VOLTAGE REGULATOR

Filed June 27, 1931

Fig- 1.

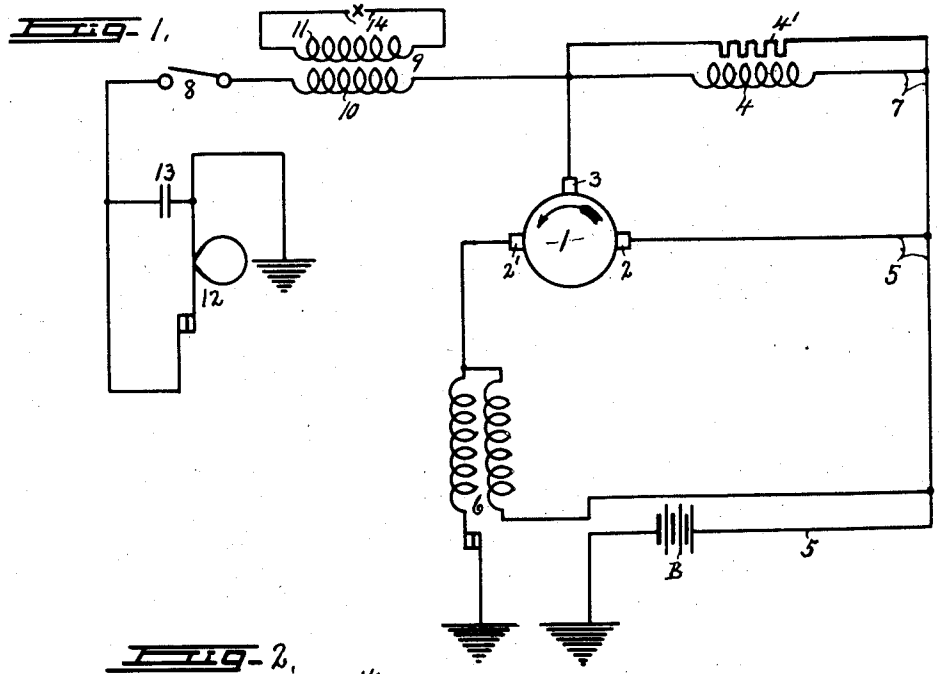


Fig- 2.

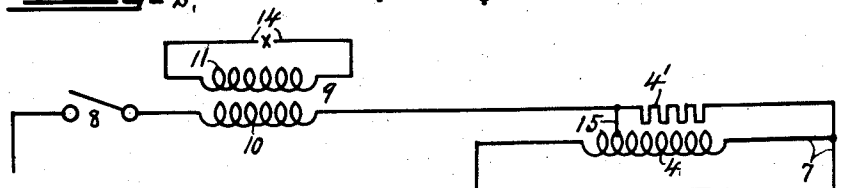


Fig- 3.

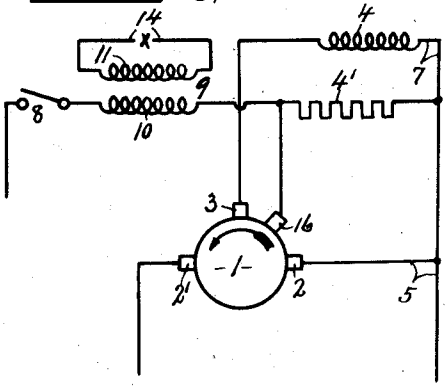
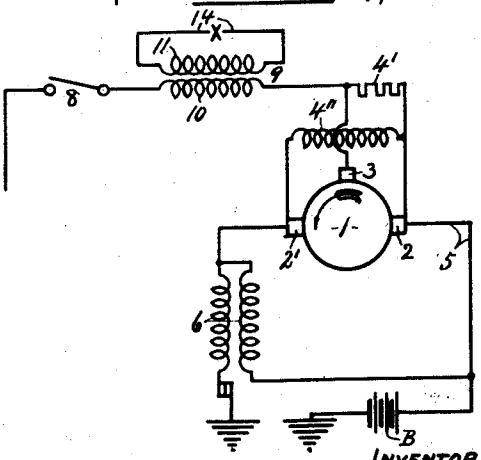


Fig- 4.



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VOLTAGE REGULATOR

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7 Claims. (Cl. 123—148)

This invention relates to an electric ignition system for variable speed internal combustion engines as commonly used in motor vehicles, involving the use of a storage battery and an engine driven dynamo electric machine, preferably of the third brush type, for supplying current to the ignition system and other translating devices with which the motor vehicle is usually equipped.

It is well known that in the ignition systems ordinarily used in apparatus of this character the time allowed for producing the necessary spark varies inversely with the speed of the engine so that under low speeds the sparking interval is relatively long, while under high speeds it is relatively short.

For example, an eight cylinder engine operating under a speed of sixty R. P. M. would cause a sparking frequency of two hundred and forty (240) per minute or a time interval of one-fourth (¼) of a second for each spark while the same engine operating under a speed of three-thousand (3000) R. P. M. would obviously give a sparking frequency of twelve thousand (12,000) per minute or a time interval of one two-hundredth (1/200) of a second for each spark so that each sparking period at the higher speed would be only one-fiftieth (1/50) of that for the lower speed.

Under these conditions it is evident that at the relatively lower speeds the time interval for each spark is sufficiently long to allow an excessively heavy current to flow through the primary winding of the spark coil, thus causing magnetic saturation of the core of the coil and resultant burning out of the breaker points which, of course, is seriously objectionable.

On the other hand when the engine and generator are running under the higher speed, the sparking interval is reduced to such an extent as to cause corresponding reduction of intensity and resultant inefficiency of the spark with a proportionate decrease in the power of the engine.

The main object, therefore, of the present invention is to provide simple and automatic means for maintaining a more uniform sparking efficiency in the ignition circuit under widely varying speeds of the engine and generator than has heretofore been practised by causing the voltage in the ignition coil to vary directly with the speed of the generator.

In other words, I have sought to provide means whereby, under the lower speeds when the sparking interval is prolonged, the voltage in the ignition circuit will be proportionately reduced to a safe limit to prevent burning of the breaker points while still maintaining the desired sparking intensity.

On the other hand, when operating under the higher speeds, with excessively short intervals for sparking, the voltage in the ignition circuit will be increased sufficiently to maintain the desired sparking intensity and resultant increase of power proportionate to the speed and thereby to give a substantially uniform spark intensity at all speeds.

Other objects and uses will be brought out in the following description.

The drawing Fig. 1 is a diagrammatic view of an electric ignition system embodying the various features of my invention.

Fig. 2 is a diagrammatic view of a portion of a similar system showing the non-inductive resistance as tapped into the shunt field winding intermediate its ends.

Fig. 3 is a diagrammatic view of a portion of a further modified system in which the primary winding of the ignition coil is connected to a fourth brush of the generator independently of the third brush.

Fig. 4 is a diagrammatic view of a portion of another modified system in which the field winding is connected across the main brushes.

As illustrated, this ignition system comprises a variable speed engine-driven dynamo-electric machine 1, preferably of the third brush type, having the usual main brushes 2 and 2', third brush 3, and shunt-field winding 4.

A storage battery B may be connected in any well known manner across the main dynamo circuit 5 for receiving current therefrom for charging purposes and may also be connected to the ignition coil and to other translating devices commonly used in motor vehicles for supplying current thereto.

An automatic cut-out 6 of the reverse current relay type preferably of the automatic reverse-relay type is connected in the main dynamo and battery circuits and is adapted to close only when the speed of the dynamo and resultant voltage output thereof reach a predetermined rate depending upon the speed of the engine by which the dynamo is driven.

The shunt field winding 4 and a non-inductive electric resistance 4' associated therewith are connected in parallel to and between the third brush 3 and main brush 2 for automatically regulating the voltage output of the generator 1 under widely varying speeds and thereby regulating the battery charging rate within safe limits, it being

understood that, under varying speeds of the generator, the voltage in the shunt field winding will vary inversely with the speed of the generator.

It is, of course, understood that under these conditions the voltage in the shunt field circuit will vary inversely with the rate of speed of the generator as usual with generators of the third brush type and that the non-inductive resistance 4' serves to produce a voltage on the ignition coil 9 that is not affected by the lag that otherwise would be due to the effect of self-induction set up in field coil 4 by the pulsations or intermittent nature of the ignition current through the coil 4.

In other words, when the generator is operating under widely varying speeds, the voltage between the main brush 2 and third brush 3 is reduced as the speed of the generator increases while the voltage between the other main brush 2' and third brush 3 will be proportionately increased due to the fact that the voltage between the brushes 2 and 3 plus the voltage between the brushes 2' and 3 must (approximately at least) equal the total voltage between the brushes 2 and 2'.

These conditions are utilized for reducing to a minimum the liability of burning out of the distributor points of multicylinder engines under the lower speeds and also for increasing the sparking efficiency of the ignition coil when the engine is running under the higher speeds as follows.

In Fig. 1, I have shown an ignition coil 9 having its primary winding 10 connected across the third brush 3 and main brush 2', thus forming what may be termed a second third brush circuit including therein a circuit breaker 12 and an electric switch 8 by which the primary circuit of the ignition coil may be closed and opened at will, the usual condenser 13 being connected across the breaker circuit.

The secondary winding 11 of the ignition coil 9 is connected in the usual manner to the spark terminals 14 of the engine and of course is directly responsive to any fluctuations of current or voltage in the primary coil which, in turn is directly responsive to the variations of voltage across the third brush 3 and main brush 2' of the dynamo as the latter is operated under widely varying speeds.

It will be observed, upon reference to Fig. 1, that the primary winding 10 of the ignition coil is electrically connected through the field winding 4 and non-inductive resistance 4' to the battery B to receive current therefrom for ignition purposes when starting the engine or while the speed of the generator is insufficient to close the relay switch 6.

On the other hand, as the engine and generator approach their maximum speed the voltage across the brushes 2 and 3 will be proportionately reduced while the voltage across the brushes 3 and 2', and therefore through the ignition coil 9, will be correspondingly increased resulting in increased intensity of the ignition spark sufficient to compensate for the reduced interval of contact between the breaker points.

The ignition system shown in Fig. 2 is the same as that shown in Fig. 1 except that the resistance 4' is directly connected in series with the primary winding 10 of the ignition coil 9 and the connection is tapped at 15 into the shunt field winding 4 at a selected point intermediate its ends for closer regulation of the voltage in the ignition circuit.

In Fig. 3, the shunt field winding is connected as usual across the main brush 2 and third brush 3 while the non-inductive resistance 4' is connected across the main brush 2 and a fourth brush 16 of the generator 1 and in series with the primary winding 10 of the ignition coil.

In the modification shown in Fig. 4, the shunt winding 4'' is connected across the main brushes 2 and 2' of the generator while the non-inductive resistance 4' is connected across the main brush 2 and a third brush 3 in series with a primary winding 10 of the ignition coil 9.

The objects of these several modifications are however, the same viz: to cause the voltage in the ignition coil 9 to vary directly and proportionately with the speeds of the generator so that under relatively low speeds the voltage in the coil will be correspondingly decreased to prevent burning of the breaker points while under relatively high speeds the voltage in the coil will be increased sufficiently to compensate for the reduced sparking interval and thereby to assure the maintenance of maximum power of the engine under all speeds.

It is evident, however, that the systems shown may be further modified within the scope of the invention and, therefore, I do not wish to limit the invention to the precise details illustrated and described.

What I claim is:—

1. The combination with a variable speed dynamo electric generator having a third brush circuit including therein an electrical resistance and a shunt field winding both connected in parallel to and between one of the main brushes and the third brush of the generator, and an external circuit connected to and between the third brush and the other main brush.

2. The combination with a variable speed dynamo electric generator having a third brush circuit including therein an electrical resistance and a shunt field winding both connected in parallel to and between one of the main brushes and the third brush of the generator, an external circuit connected to and between the third brush and the other main brush, and a storage battery connected across the main brushes of the generator and to corresponding ends of the shunt field winding and resistance.

3. In an electric ignition system for internal combustion engines, an engine-driven dynamo electric generator having a third-brush circuit including therein an electrical resistance, and a shunt field winding both connected in parallel to and between one of the main brushes and third brush of the generator, and an ignition coil having its primary winding connected to and between the third brush and the other main brush.

4. The combination with a variable speed dynamo electric generator having a third brush circuit including therein an electrical resistance connected to and between one of the main brushes and the third brush, and an external circuit connected to the third brush and to the other main brush, and a shunt field winding connected across the main brushes of the generator.

5. The combination with a variable speed dynamo electric generator having a third brush circuit including therein an electrical resistance connected to and between one of the main brushes and the third brush, and an external circuit connected to the third brush and to the other main brush, said generator having a fourth brush circuit including therein a shunt field winding.

6. In an electric ignition system for internal combustion engines, an engine-driven dynamo electric generator having a third brush circuit including therein an electrical resistance connected to one of the main brushes and to the

third brush, an external circuit including therein the primary winding of an ignition coil connected to the third brush and to the other main brush of the generator, and a shunt-field winding connected across the main brushes of the generator.

7. In an electric ignition system for internal combustion engines, an engine-driven dynamo electric generator having a third brush circuit including therein an electrical resistance connected to one of the main brushes and to the third brush, and an external circuit including therein the primary winding of an ignition coil connected to the third brush and to the other main brush of the generator, said generator having a fourth brush circuit including therein a shunt field winding.

ALBERT E. DOMAN.