Aug. 9, 1949. W. B. SMITS 2,478,672

ELECTRICAL IGNITION SYSTEM, PARTICULARLY ADAPTED FOR COMBUSTION ENGINES

Filed Oct. 18, 1946

Fig. 1.

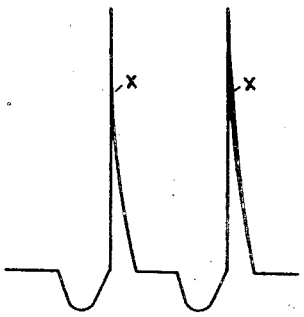


Fig. 2.

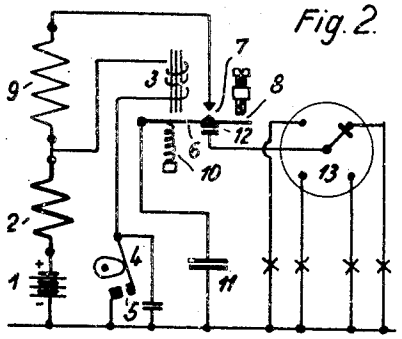


Fig. 3.

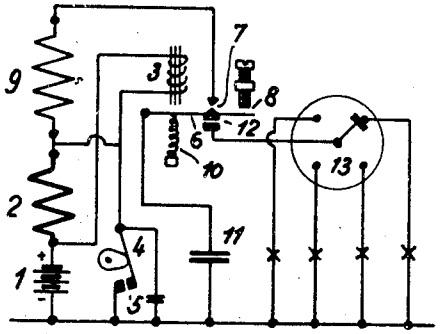


Fig. 4.

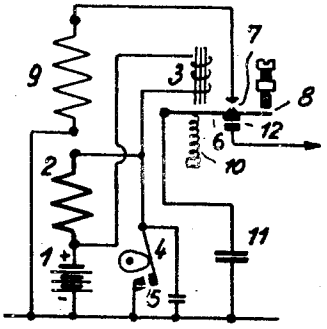


Fig. 5.

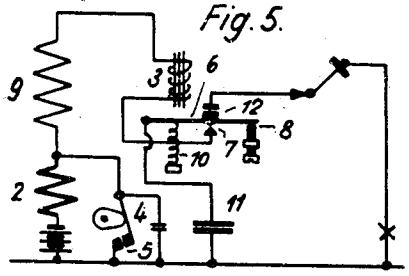


Fig. 6.

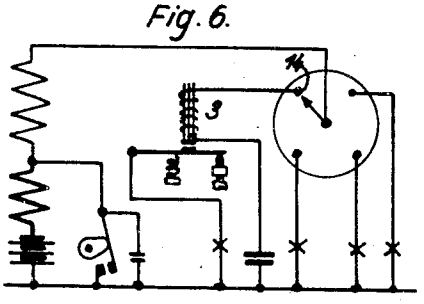
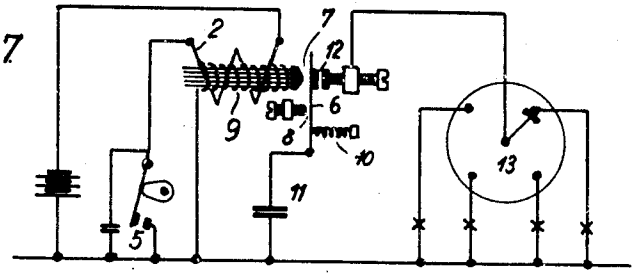


Fig. 7.



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ELECTRICAL IGNITION SYSTEM, PARTICULARLY ADAPTED FOR COMBUSTION ENGINES

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3 Claims. (Cl. 123—148)

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The invention relates to an electrical ignition system, particularly adapted for internal combustion engines and comprising means for electric generation, for example an induction coil for the production of current impulses the voltage of which is 3000 volts or higher. The objective of the invention is to provide an apparatus producing periodically an ignition spark of very short duration and great intensity. This is accomplished (in the invention) by means of a condenser, which is charged periodically directly or through a spark gap by said induction coil or the like, and of an oscillating switch or like device adapted to connect said condenser for its discharge to a spark gap for the igniting spark, e. g. a sparking plug, immediately after the generation of each charging impulse.

Advantageously said switch may be constituted as an oscillating throw-over switch, which is changed over by an electro-magnet in synchronization with the charging impulses and which throws the condenser over from the induction coil to the spark gap for the igniting spark, e. g. the sparking plug.

These and other features of the invention will be explained in detail hereinafter with the aid of the drawings.

In the drawings:

Fig. 1 is a diagram of charging impulses.

Figs. 2–7 are diagrams of connections of different embodiments of the invention.

It is known that if in an induction coil the magnetic flux breaks suddenly down a voltage impulse of high amplitude is generated in the secondary winding of said coil. Said voltage impulse can be represented by an E-function as is illustrated in Fig. 1. When a condenser is connected to and disconnected from said secondary winding at the right moments it can be charged, depending upon the capacity of the condenser and that of the induction coil, to a voltage value, which is high in comparison with the voltage of the battery supplying the primary winding of the induction coil.

Fig. 2 shows a first embodiment of the invention. Therein 1 denotes a battery, which feeds a circuit comprising the primary winding 2 of an autotransformer 2, 9 constituting an induction coil, the coil 3 of a magnetic throw-over switch and an interrupter 4 having contacts 5 controlled by a rotary cam member. When the contacts 5 are closed, current is flowing through primary 2 and magnet coil 3 and the latter attracts its armature 6 so that contacts 7 are closed or, dependent upon the adjustment of a screw 8, spaced

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apart a relatively small distance, say 0.004". If contacts 5 are interrupted by the cam member, the magnetic flux of the autotransformer 2, 9 breaks down and excites a high tension impulse in the secondary winding 9. This impulse is conducted, for charging purposes, through the closed or slightly spaced contacts 7 to a condenser 11. At the same time the magnet coil 3 is de-energised so that it frees the armature 6 permitting it to be withdrawn by a spring 10. The time-constant of magnet coil 3, the inertia of armature 6 and the power of spring 10 are chosen in such a manner, that the interruption by contacts 7 of the charging circuit occurs at a convenient moment, that means at a moment at which the voltage of the charging impulse is still high, so that condenser 11 is charged at a relatively high voltage.

It may be noted that the impedance of primary 2 and the inner-resistance of battery 1 do not affect appreciably the excitation of the charging impulse.

A short time after the interruption of the charging circuit by contacts 7 the armature 6 closes contacts 12 connecting condenser 11 to the rotary contact of a distributor 13, the fixed or lead-off contacts of which are connected to the sparking plugs of the combustion engine. The cam member of interrupter 4 and the rotary contact of distributor 13 are connected in such a way, that every time the contacts 12 are closed the rotary contact of the distributor passes a fixed contact thereof so that condenser 11 is discharged through a sparking plug causing an ignition spark of very short duration and great intensity.

The apparatus according to Fig. 3 differs from that shown in Fig. 2 by the fact, that the magnet coil 3 is shunted to the primary winding 2 instead of being connected in series therewith.

In Fig. 4 the induction coil is constituted as a normal transformer having its primary and secondary windings 2 and 9 separated from each other. The coil 3 is shunted to primary 2.

In Fig. 5 the coil 3 of the magnetic throw-over switch and the high tension winding 9 of the induction coil are connected in series. When interrupter 4 breaks the circuit of primary 2, the impulse generated in the secondary 9 flows through coil 3, over contacts 7 and charges condenser 11. The magnet excited by the high tension impulse attracts the armature, breaks contacts 7 and closes contacts 12 permitting condenser 11 to be discharged through a sparking plug. In this case interrupter 4 and the distributor must be well synchronised since the

armature 6 is drawn back by spring 10 and contacts 7 are reclosed immediately after the production of the charging impulse.

Fig. 6 shows an ignition device in which three of four sparking plugs are connected to the high tension winding of the induction coil by means of the distributor in the normal way. The fourth sparking plug is connected to the armature of a magnetic switch, the coil 3 of which is inserted between the remaining lead-off contact 14 of the distributor and a condenser. When the rotary arm of the distributor passes contact 14, the condenser is charged by the high tension impulse. A very short time afterwards coil 3 attracts the armature permitting the condenser to get discharged through the sparking plug. The device consisting of the condenser and the magnetic switch can be constructed as a compact unit adapted to be readily inserted between the end of the normal high tension cable and the sparking plug.

This device has the advantage that ignition can go on in a cylinder which is badly leaking and permits oil, and as a consequence thereof carbon particles, to be deposited on and between the electrodes of the sparking plug, said oil thus preventing the plug from sparking in the normal way by high tension impulses. In contrast, the sparking by discharging of a condenser is the better the more the gap between the plug electrodes are bridged by semi-conductive material such as a layer of carbonised oil. Repair of the engine may then be postponed till a more convenient time.

In the embodiments, according to Figs. 2–6, ordinary induction coils 2, 9 may be used. The induction coil and the battery may be replaced by a normal rotary ignition magneto, in which a permanent magnet rotates in a system having fixed armature coils or the reverse.

In Fig. 7 the primary winding 2 of the induction coil is used at the same time as a magnet coil for the attraction of the throw-over switch. When contacts 5 of the interrupter are separated by the cam member, and thus the primary circuit of the induction coil 2, 9 is interrupted, a charging impulse is excited in secondary winding 9. Since attraction of armature 6 by the magnet yoke of the induction coil then ceases, the armature is withdrawn by spring 10 so that contacts 7 open and contacts 12 close permitting condenser 11 of discharging through distributor 13 and one of the sparking plugs.

It has been found, that voltages of 3000 volts are sufficiently high to charge a condenser of certain capacity in such a manner, that while discharging through a sparking plug, it gives very satisfactory ignition sparks. This means that ignition systems according to the invention may be constructed for voltages of about 3000 volts instead of the usual voltages between 15,000 and 30,000 volts. It will be evident that induction coils or magnetos and cables for 3000 volts are much cheaper, more reliable and smaller or thinner than the ordinary coils or ignition magnets, which have to withstand voltages as high as 15,000–30,000 volts.

It may be noted, that the armature of the throw-over switch may be operated mechanically by a member driven synchronously with said interrupter or the magneto, for instance by a cam member mounted on the shaft of the magneto. It must be kept in mind that the change-over action of the switch must take place at the point of the E-function curve which is most favourable for charging the condenser.

It is of great importance that the frequency of natural vibration of the throw-over switch is always higher than that of the maximum number of sparking impulses which has to be conducted through said switch. The frequency of the natural vibration of the change-over switch depends on the inertia of the armature and the, preferably adjustable, tension of spring 10.

What I claim is:

1. An electrical ignition system for use with internal combustion engines, comprising, in combination, a condenser, a circuit for periodically loading said condenser, a generator for the generation of electrical loading impulses, said generator forming part of said loading circuit, a circuit for periodically discharging said condenser, a spark plug forming part of said discharge circuit and an electro-magnetic switch having an electro-magnet and a movable contact, said switch forming part of both the loading circuit and the discharge circuit, said electro-magnet being excited immediately after the generation of each loading impulse and thereby producing one oscillation of said movable contact and a momentary truly ohmic connection between the condenser and the spark plug.

2. In an ignition system as claimed in claim 1 said electro-magnetic switch being a throw-over switch of which the movable contact is moved, immediately after the production of an impulse, one time to and fro between a position in which the condenser is connected to the generator and a position in which it is disconnected from the generator and connected to the spark plug.

3. In an ignition system as claimed in claim 1 a distributor having a scanning contact and fixed terminal contacts, said distributor being inserted in the loading circuit, said scanning contact being connected to the impulse generator, at least one terminal contact being connected to the series connection of the electro-magnet of the switch and the condenser and the series connection of the spark plug and said switch being connected parallel to said condenser.

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