

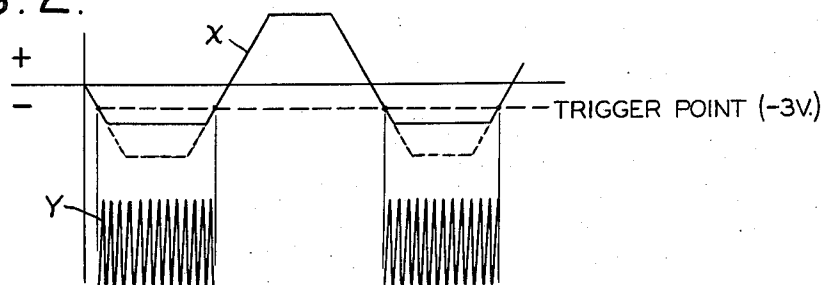
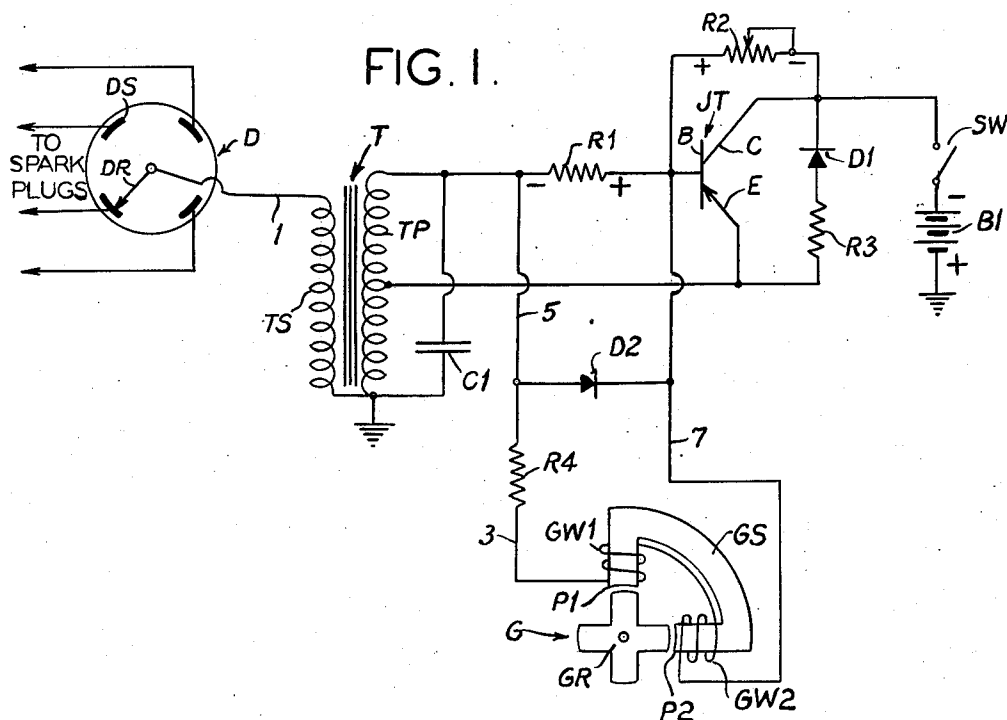
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2,898,392

IGNITION SYSTEMS

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2,898,392

IGNITION SYSTEMS

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8 Claims. (Cl. 123—149)

This invention relates to ignition systems, and more particularly to transistorized automotive ignition systems.

Among the several objects of the invention may be noted the provision of ignition systems which automatically and precisely control the advance and retardation of spark in response to engine speed variations; the provision of ignition systems of the class described which insure improved flame propagation; and the provision of such ignition systems which are simple and inexpensive in construction and reliable in operation. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the constructions hereinafter described, the scope of the invention being indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention are illustrated,

Fig. 1 is a schematic and circuit diagram of an ignition system of the present invention;

Fig. 2 illustrates the wave patterns at certain points in the ignition system at low engine speeds; and,

Fig. 3 illustrates the wave patterns at certain points in the ignition system at higher engine speeds.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

Referring now to Fig. 1, an automotive type distributor is indicated at D. A distributor rotor DR is interconnected by a wire 1 to a secondary TS of a step-up transformer T. Rotor DR is mechanically driven in the usual manner by an internal-combustion engine (usually from the cam shaft), so as to sweep the rotor across several distributor stator contacts DS which are in turn electrically connected to the engine spark plugs as indicated. Transformer T, which is preferably of the type used as the high voltage transformer in conventional television sets, has a primary winding TP. The TP:TS turns ratio is such that a secondary voltage of approximately 10 to 15 kv. is developed. Transformer T may be of the laminated, air or compacted powdered iron core types. One end of primary TP is commonly connected to the other side of secondary TS and grounded, while the opposite terminal of TP is connected through a resistor R1 to the base B of a junction transistor JT. Primary TP is shunted by a condenser C1 to form an LC tank which resonates within a preferred frequency range of about 15 to 20 kc. A tap of winding TP is connected to emitter E of transistor JT. The basic oscillator circuitry of Fig. 1 also includes an adjustable bias resistor R2, interconnecting the collector element of JT to its base B, and a source of D.C. power B1, such as a 12 v. automotive storage battery interconnected through an ignition switch SW to collector C.

This oscillator circuit, constituted by transistor JT connected in a common-emitter configuration with its associated components including the LC tank and resistors R1 and R2, optionally but preferably also includes a resistor R3 and a protective limiter diode D1 series-

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connected between collector C and emitter E to protect transistor JT from high inverse voltage peaks. This oscillator under proper biasing conditions will oscillate and supply high voltage at a frequency of 15 kc. to rotor DR.

In order to pulse or key this A.C. potential applied to DR, a pair of serially connected generator windings GW1 and GW2 are shunt-connected by means of a wire 3, a resistor R4, a wire 5, and another conductor 7 across resistor R1. A diode limiter D2 is also electrically shunted across R1. The windings GW1 and GW2 are wound on two generator poles P1 and P2 magnetically interconnected by the iron path provided by a generator stator element GS. A flux field through GS is established by a polarized generator rotor GR positioned in a magnetic relationship between poles P1 and P2. This rotor is of permanent magnetic material, such as Alnico, and is driven by the internal-combustion engine in a timed relationship therewith (half speed in the illustrated embodiment). The rotation of rotor GR varies the flux cutting windings GW1 and GW2, thus generating an A.C. signal having a frequency and an amplitude which are functions of engine speed. The wave form of this signal is preferably modified, as will be explained in more detail hereinafter by the R4—D2 circuit and impressed across R1.

Operation is as follows:

Upon closing the ignition switch SW, the D.C. potential of battery B1 is applied across the transistor base-collector circuit, which includes the LC tank circuit and R1 series-connected therewith. The parameters of R1 and R2 (e.g., 100Ω and 200Ω, respectively) are such that a small biasing potential of about 1 v. is developed across base B-collector C by the voltage drop across R2.

The generator G produces an A.C. signal (across wires 3 and 7) having the wave shape X (Fig. 2) of a somewhat truncated sine wave. The action of D2 and R4 limit the negative excursions of this A.C. signal, cutting off the dashed portion of wave X.

The signal of a wave shape as indicated by the solid line portions of wave X causes a potential in accordance therewith to be developed across resistor R1, which varying potential modifies the current through R2 and thus the potential between base B and collector C of transistor JT. At a predetermined point, referred to and illustrated as the trigger point (e.g., —3 v.), across wires 5 and 7, the net biasing potential becomes such that transistor JT conducts heavily, initiating oscillation in the LC tank. This trigger point value may be varied as desired by adjustment of rheostat R2. With a capacitance of about 50 to 100 mfd, at C, the LC tank will provide an A.C. signal at a frequency of about 15 kc., the amplitude of which is stepped up by the transformer action of T to a potential of about 10 to 15 kv. This oscillation, indicated by the wave form Y, continues until the amplitude of the generator signal decreases and wave X becomes more positive than —3 v., the pre-selected trigger point. Thus, timed pulses of 15 kc. are produced, being initiated by the A.C. generator signal exceeding —3 v. in a negative direction and being cut off by the signal falling back below this trigger point level. The duration of this pulse is therefore controlled by the operation of generator G. At higher engine speeds, the frequency and amplitude of the A.C. generator signal are increased, as shown in Fig. 3. The wave form of the signal is illustrated at X1. The slope of the flat wave side steepens at this higher speed, thereby intersecting the trigger level at a point earlier along the time base. This action inherently advances the initiation of the 15 kc. spark pulses as indicated at Y1, thus giving automatic spark advance.

The limiter or clipper action of diode D2 is important

in that it prevents overdriving of transistor JT, which would cause modulation of the 15 kc. signal pulses at the rotational frequency of rotor GR.

It is to be noted that the four pole rotor GR is rotated at one half the engine speed, or at the same speed as the cam shaft. For six and eight cylinder engines the rotor configuration or speed is appropriately modified. Also, the wave form of the output of generator G may be modified from that shown by changing the shape of the rotor and/or faces of pole pieces P1 and P2. More than one spark pulse per cylinder explosion may be obtained by providing several notches in the rotor, instead of providing continuous ignition over each burning cycle, as is the case in the illustrated embodiment. Also, it is to be understood that junction transistors of the PNP as well as the NPN type may be used, if the customary

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. In an ignition system for an internal-combustion engine having a plurality of spark plugs and a distributor having a rotor driven by the engine, said distributor being electrically interconnected to said plugs to supply sequentially thereto a series of timed high-voltage high-frequency electrical pulses; means for generating said series of timed high-voltage pulses comprising an oscillator having an LC resonant tank circuit, a step-up transformer including at least a portion of the inductance of said tank circuit in the primary winding thereof and having a secondary winding electrically connected to said distributor rotor, said oscillator including a transistor and a biasing resistor responsive to a voltage of predetermined amplitude to actuate said oscillator, and a generator driven by said engine in timed relation therewith, said generator being connected to vary the voltage across said biasing resistor and adapted to provide a series of shaped electrical pulses having a wave form the amplitude and slope of the

leading edge of which are functions of engine speed, whereby the time of actuation of said oscillator is increasingly advanced as the engine speed increases.

2. In an ignition system as set forth in claim 1, said generator having a rotor and a stator, said rotor being of permanent magnetic material and driven from a cam shaft of said engine, and said stator having poles which are shaped relative to the generator rotor to provide a generally truncated sinusoidal wave form.

3. In an ignition system as set forth in claim 1, said biasing resistor being adjustable to vary the predetermined amplitude at which said transistor oscillator is actuated.

4. In an ignition system as set forth in claim 1, said transistor being connected in a common emitter configuration and having base, collector and emitter electrodes, said biasing resistor being connected between said base and collector, and said tank circuit being series connected with a source of D.C. power between said base and collector.

5. In an ignition system as set forth in claim 4, a second resistor serially connected between said tank circuit and said transistor base, said generator being connected across said second resistor.

6. In an ignition system as set forth in claim 5, a diode limiter shunted across said second resistor whereby excursions of one polarity of said electrical pulse wave form are clipped.

7. In an ignition system as set forth in claim 6, a second diode and resistor being serially connected between said collector and emitter.

8. In an ignition system as set forth in claim 7, said components of said LC circuit having parameters which provide a resonant oscillator frequency of approximately 15 to 20 kc.

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UNITED STATES PATENT OFFICE
CERTIFICATE OF CORRECTION

Patent No. 2,898,392

August 4, 1959

Ralph L. Jaeschke

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction and that the said Letters Patent should read as corrected below.

Column 3, line 16, after "customary" insert -- polarity reversals are made. --.

Signed and sealed this 12th day of January 1960.

(SEAL)

Attest:

KARL H. AXLINE

Attesting Officer

ROBERT C. WATSON
Commissioner of Patents