

[54] **AC IGNITION SYSTEM**
 [76] Inventor: **Miodrag Rakitch**, 4 Honey Dr., Scarborough, Ontario, Canada
 [22] Filed: **Jan. 13, 1972**
 [21] Appl. No.: **217,601**

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[30] **Foreign Application Priority Data**
 Mar. 26, 1971 Canada 108785

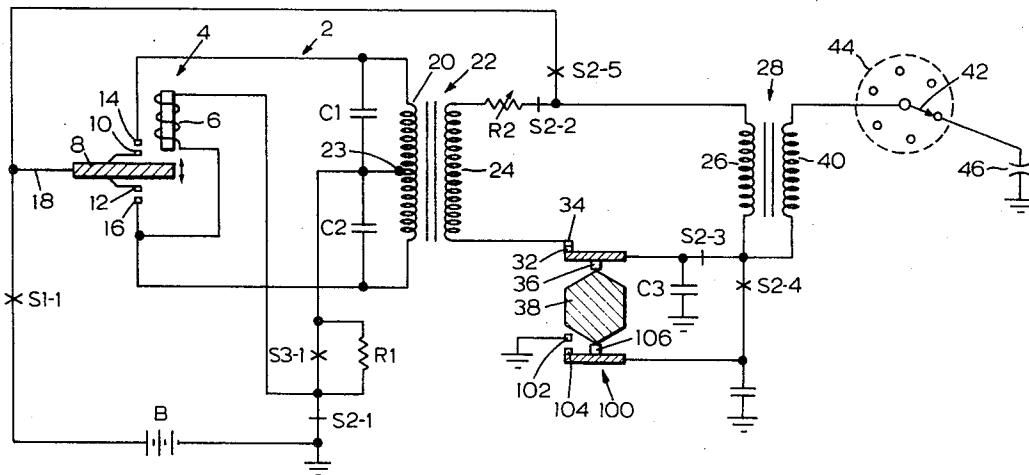
[52] **U.S. Cl.**... 123/148 AC, 123/148 E, 123/148 B, 123/148 S, 123/148 DC
 [51] **Int. Cl.**..... F02p 3/02, F02p 3/04
 [58] **Field of Search**..... 123/148 E, 148 AC, 123/148 DC

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Primary Examiner—Laurence M. Goodridge
Assistant Examiner—Ronald B. Cox
Attorney—David M. Rogers et al.

[57] **ABSTRACT**
 An AC ignition system for automobiles, in which a vibrator operating at between 60 and 120 cycles per second supplies AC current through a transformer and through a set of normally open points to the primary of an ignition coil. When the points close, the coil is energized with AC and delivers high voltage to a spark plug during the time when the points are closed.

1 Claim, 2 Drawing Figures



AC IGNITION SYSTEM

This invention relates to an AC ignition system for internal combustion engines.

Most internal combustion engines (for example all gasoline engines) must have an ignition system. There are presently three types of ignition systems in use, namely DC ignition systems, electronic ignition systems, and magnetic ignition systems. The most common type of ignition system presently in use is the DC ignition system, which includes an ignition coil and a set of points which open at predetermined times to cause a rapid collapse of the magnetic field in the primary of the coil, creating a high voltage at the secondary of the coil to energize spark plugs.

The disadvantage of the conventional DC ignition system is that the points are closed for substantial periods of time, causing excessive heating of the points and coil. This increases pitting and corrosion of the points, leading to failure of the ignition system. In addition, the spark is often not sufficiently hot or of sufficient duration in the winter to ignite the vaporized gasoline mixture in the engine.

Electronic ignition systems largely overcome the problem of pitting and corrosion of the points, but such ignition systems are expensive and are too complicated for the average mechanic to service. The magneto ignition system has the disadvantage that each spark plug must have its own electrical system, and in addition considerable mechanical starting power is required for the engine since rotation of the engine is needed to generate a spark.

The present invention provides an AC ignition system which reduces overheating of the coil and points and which produces a hot spark at all times. According to the invention, an AC source is connected to the primary of the ignition coil through points which are normally open, and which close only when a spark is desired. Since no current flows through the points or coil during most of each cycle, overheating of the points and coil is reduced. In addition, a longer spark is provided, lasting the entire interval during which the points are closed, thus improving starting in cold or wet weather.

Further objects and advantages of the invention will appear from the following description, taken together with the accompanying drawings, in which:

FIG. 1 is a schematic diagram showing an AC ignition system according to the invention; and

FIG. 2 is a top view, partly in section, of a set of points for use with the ignition system of FIG. 1.

In the drawings, detached contact notation is used for the switches shown in FIG. 1. Thus, an X indicates a switch contact which is open when the switch is in its normal condition, and a "-" indicates a switch contact which is closed when the switch is in its normal condition. The notation "S1-1" (for example) in the drawings denotes contact number 1 of switch S1.

Reference is first made to FIG. 1, which shows an ignition system having a source 2 of AC current. The source 2 includes a conventional vibrator 4 having a coil 6 and an interrupter member 8 equipped with a pair of contacts 10, 12 which co-operate with fixed contacts 14, 16. The contacts 10, 12 are connected together to a lead 18 which is connected through a contact S1-1 of the ignition switch S1 to one terminal of a battery B. The other terminal of battery B is connected through a normally closed switch contact S2-1

of another switch S2 to one side of the vibrator coil 6. The other side of vibrator coil 6 is connected to fixed contact 16.

The fixed contacts 14, 16 of the vibrator are connected to respective ends of a primary winding 20 of a transformer 22. Primary winding 20 has a centre tap 23 which is connected through resistor R1 to switch contact S2-1. Capacitors C1, C2 are connected between centre tap 23 and fixed contacts 14, 16 respectively.

One terminal of secondary winding 24 of transformer 22 is connected through a resistor R2 and through a normally closed contact S2-2 of switch S2 to the primary winding 26 of a conventional ignition coil 28. The other terminal of primary winding 26 is connected through normally closed contact S2-3 of switch S2 to the movable arm 28 of a set of points 30.

The movable arm 28 of points 30 carries a contact 32 which co-operates with a fixed contact 34. Arm 28 is normally biased (by a spring, not shown in FIG. 1) to a position in which contacts 32, 34 do not engage. However, arm 28 contains the usual cam follower 36 operated by the distributor cam 38 to close contacts 32, 34 at times when a spark is required. Contact 34 is connected to the other terminal of transformer secondary winding 24.

The system illustrated operates as follows. When the ignition switch S1 is operated, current is supplied to the vibrator winding 6 (the vibrator interrupter member 8 is normally biased downwardly so that contacts 12, 16 engage, as is normal) thus operating the vibrator. The vibrator is set to operate at between 60 and 120 cycles per second. When the vibrator operates, a square-wave current at twice the vibrator frequency is fed to the transformer primary winding 20. Very high frequency components are filtered out by capacitors C1 and C2, which may typically be 400 microfarads each.

Each half of the primary winding 20 is designed to accept approximately 11.5 volts. Resistor R1 absorbs the remaining 0.5 volts, so that the system will operate with a 12 volt battery. Resistor R1 is bypassed by a normally open switch contact S3-1, so that when switch S3 is closed, additional voltage is supplied to the transformer for better starting. If desired, contact S3-1 may be a contact of the ignition switch.

The secondary winding 24 of transformer 22 is wound to deliver about 16 volts at 6 amperes. The resistor R2 is selected to reduce the voltage depending upon the requirements of the particular ignition coil 28 used with the system. When the vibrator operates, supplying the primary and hence the secondary of transformer 22 with AC current, the current is conducted at properly timed intervals through the contacts of the points 30 to the primary of the ignition coil 26, producing a high AC voltage at the secondary 40 of the ignition coil. The high voltage AC is conducted through a conventional rotor 42 of a distributor 44 to spark plugs diagrammatically indicated at 46 and hence to ground.

It has been found, surprisingly, that the vibrator can be operated at between 60 and 120 cycles per second, even though the engine is operating at high speed. For example, if the engine is an eight cylinder engine operating at 4,000 revolutions per minute, then the points will open and close about 270 times per second, which is substantially higher than the vibrator frequency. However, it is found that a steady spark is produced and good engine operation is obtained even at high

speeds, using a low vibrator frequency. This results in part caused by the fact that the effective frequency of the dominant component of the AC voltage at the transformer 22 is twice the vibrator frequency, i.e., it is between 120 and 240 cycles per second. In addition, the waveform at the transformer secondary 24 is by no means a perfect sine wave, because the vibrator produces a square-wave which is not fully filtered by capacitors C1, C2, particularly at the current levels required by the average coil (ignition coils usually require between 3 and 6 amperes). The distortion and medium frequency components present in the waveform at the transformer secondary, which are increased by normal transformer distortion, help to ensure that there will be a rapid change of current at the ignition coil primary whenever the points are closed. Very high frequency components are of course removed by capacitors C1 and C2 since they tend to reduce the performance of the device.

With the invention, for a one cylinder four cycle engine, the points 30 are open for about $3\frac{3}{4}$ cycles and are closed only for about one-fourth cycle of less. In contrast, with a corresponding DC system, the points would be closed for $3\frac{3}{4}$ cycles and open only for one-fourth cycle.

It will be noted that the circuit between the secondary 24 of transformer 22 and the primary 26 of coil 28 is not grounded, except through capacitor C3. It is found that this improves performance considerably as compared with a system in which the points are directly grounded. Capacitor C3 may typically be 50 microfarads, but other values may be used.

Since, in the preferred form of the invention, the points 30 are insulated from ground, a special set of points is used, as shown in FIG. 2. The points 30 shown in FIG. 2 include a standard metal mounting plate 50 adapted to be fastened to the distributor of an automobile. The mounting plate 50 carries an insulating bushing 52 on which the movable arm 28 is pivoted. Bushing 52 is held in place by a metal shaft 54 and by a conventional C washer, not shown. Arm 28 is biased to the open position shown in FIG. 2 by a conventional copper spring 58 fixed to an insulated post 60 by terminal nuts 62. One lead for the points is connected between nuts 62. The fixed contact 34 is mounted on a fixed arm 64 which is also held to the insulated post 60 by clamping between a fiber washer 68 and the insulated post 60. The other lead for the points 30 is connected to arm 64. Movement of the arm 28 away from fixed contact 34 is limited by an insulating bushing 70 mounted on a metal post 72. In this manner, the electrical contacts of the points are completely insulated from ground.

As illustrated in FIG. 1, the AC ignition system shown may be coupled with a conventional DC ignition system, for use in case of vibrator failure. The DC ignition system includes a conventional set of points 100 having a grounded fixed contact 102 and a movable contact 104 arm carrying a cam follower 106 to open the points 100 at desired times. Arm 104 is connected through a normally open contact S2-4 of switch S2 to one end of the coil primary winding 26, and the other end of the coil primary winding 26 is connected through another normally open contact S2-5 of switch S2 and through the ignition switch contact S1-1 to the battery. Thus, when switch S2 is operated, the AC ignition system is removed from the circuit and the DC igni-

tion system is substituted for it. The vibrator is deenergized at this time by switch contact S2-1.

It will be appreciated that although the AC supply 2 has been shown as including a vibrator, other types of invertors can be used to supply alternating current. If electronic invertors are used, they can be operated at relatively high frequencies, depending on the design of the coil 28. However, as discussed, it is found that with conventional coils, even a relatively low frequency will do, particularly with invertors of the type which produce a chopped or rectilinear wave AC.

In addition, the AC source can if desired be connected to the ignition coil primary through a suitable thyristor. The thyristor is controlled by the points, which close to turn on the thyristor and complete the AC current to the coil primary at times when sparks are required. This reduces the current through the points, as in a transistor ignition, but at the cost of increased complexity.

I claim:

1. For an internal combustion engine of the type including an ignition coil having a low voltage primary winding and a high voltage secondary winding, spark plugs connected to said secondary winding, a rotary cam adapted to operate ignition points, and a battery having a pair of terminals, one of said terminals being connected to ground, an improved AC ignition system comprising:

a. a first set of ignition points insulated from ground and comprising a metal mounting plate, a fixed contact mounted on said plate and insulated therefrom, an insulated bushing mounted on said plate, a movable arm mounted on said bushing and carrying a second contact engageable with said fixed contact, spring means biasing said movable arm away from said fixed contact thereby biasing said points to open condition, actuating means mounted on said movable arm and co-operating with said cam for said cam to close said first set of points at times when a spark is required, and an insulated stop on said mounting plate to limit movement of said arm away from said fixed contact,

b. a capacitance connected between said points and ground,

c. an inverter for producing a substantially rectilinear AC voltage, said inverter comprising a vibrator, a transformer having a centre tapped primary winding and a secondary winding, said vibrator having a pair of fixed contacts and a contact movable between said fixed contacts, means connecting said movable contact to one terminal of said battery, means connecting each fixed contact to respective sides of said primary winding of said transformer, means connecting the centre tap of said primary winding of said transformer to the other terminal of said battery, and first circuit means connecting said secondary winding of said transformer through said first set of points to said primary winding of said ignition coil, (d) a second set of ignition points normally in closed condition and mounted to co-operate with said cam for said cam to open said second set of ignition points when a spark is required,

d. second circuit means for connecting the primary winding of said ignition coil to said terminals of said battery through said second set of ignition points,

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f. and switch means normally interrupting said second circuit means thereby normally rendering said second set of points inoperative, said switch means including means operable to disconnect said inverter from said primary winding of said ignition 5

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coil and to close said second circuit means thereby rendering said second set of points operative and said first set of points inoperative.

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