

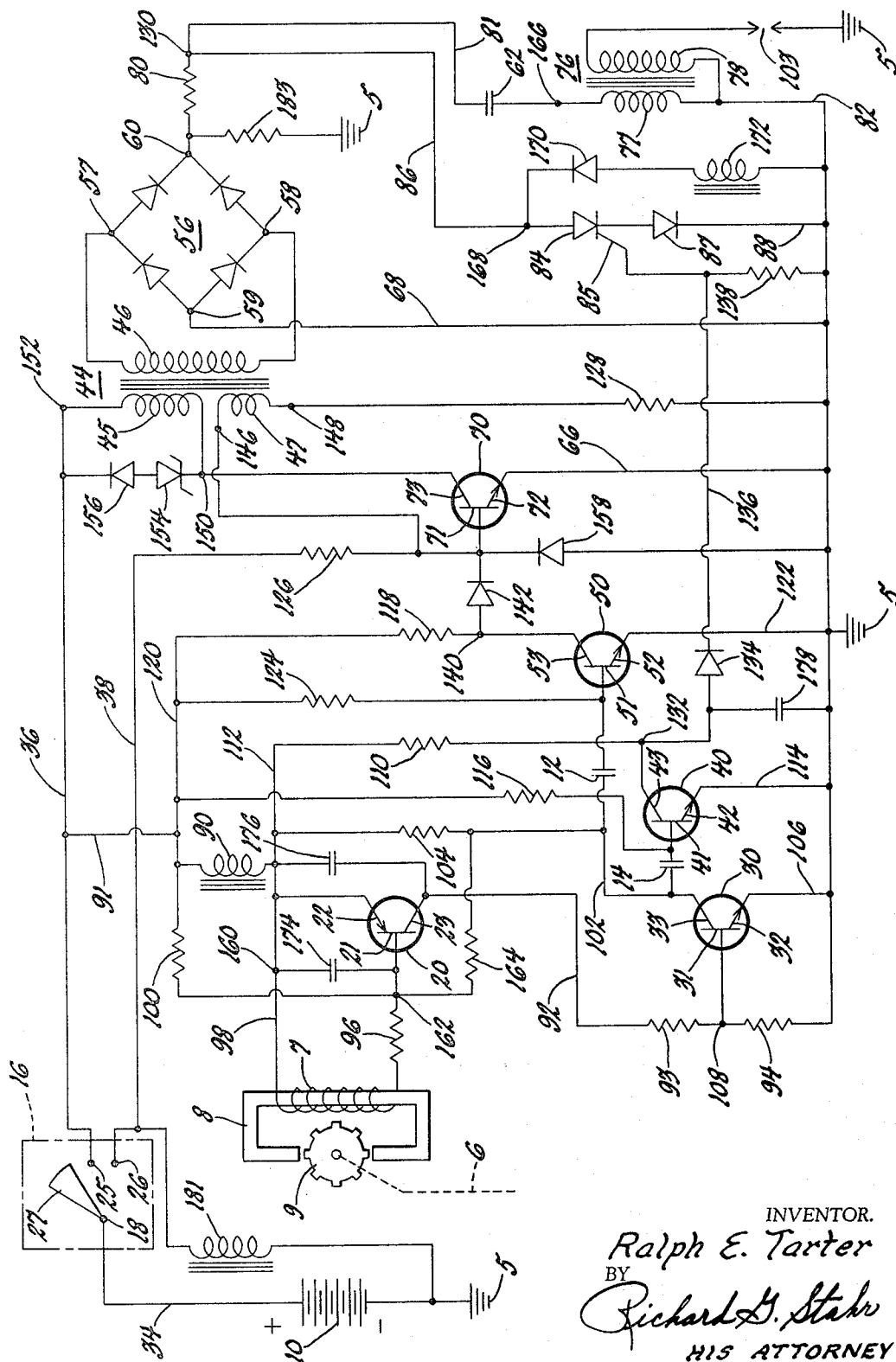
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CAPACITOR DISCHARGE IGNITION SYSTEM

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1

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CAPACITOR DISCHARGE IGNITION SYSTEM
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This invention relates to capacitor discharge ignition systems and, more specifically, to capacitor discharge ignition systems of the type in which the magnitude of the secondary potential available to fire the spark plugs of an internal combustion engine is substantially independent of supply potential magnitudes.

With cold weather conditions, the terminal voltage of an automotive storage battery may drop to a very low value while the starter motor is cranking the engine. In most inductive and capacitor discharge ignition systems, the secondary potential available to fire the spark plugs during cranking is approximately proportional to battery potential for a given system. This is a serious disadvantage of systems of this type in that with the conditions under which it is most difficult to start an internal combustion engine, the available battery potential is of the lowest magnitude.

An ignition system of this type in which the magnitude of the secondary potential available to fire the spark plugs is substantially independent of supply potential magnitudes, particularly during the cranking operation, would materially reduce or eliminate this particular disadvantage of the prior art systems.

It is, therefore, an object of this invention to provide an improved capacitor discharge ignition system for internal combustion engines.

It is another object of this invention to provide an improved capacitor discharge ignition system for internal combustion engines wherein the magnitude of secondary potential available to fire the spark plugs is substantially independent of supply potential magnitudes, particularly during the cranking operation.

In accordance with this invention, a capacitor discharge system for internal combustion engines is provided wherein an electronic converter circuit inverts the direct current supply potential of the system, transforms the inverted potential to a potential of a higher magnitude and rectifies the higher magnitude potential to charge the storage capacitor continuously when the engine is being cranked to start and in response to a trigger signal derived from the amplified ignition signal pulses produced by a magnetic pulse generator driven in synchronism by the engine when the engine is running normally after starting.

For a better understanding of the present invention, together with additional objects, advantages and features thereof, reference is made to the following description and accompanying single figure drawing which schematically sets forth one embodiment of the capacitor discharge ignition system of this invention.

As the point of reference or ground potential is the same point electrically throughout the system, it has been illustrated by the accepted symbol and referenced by the numeral 5 throughout the drawing.

The capacitor discharge ignition system of this invention may be used with internal combustion engine and in combination with a direct current potential source having positive and negative terminals, shown as a conventional battery and referenced by the numeral 10 in the drawing.

To produce ignition signal pulses in synchronism with the engine for ignition timing purposes, a magnetic pulse generator may be employed. This generator is schematically illustrated in the drawing and includes a permanent magnet rotor member 9, a pole piece 8 of an easily mag-

2

netized material and a pick-up coil 7. Rotor member 9 may be mounted on the free end of the shaft of a conventional distributor which is driven in synchronism with the engine by the engine. The distributor shaft has been schematically illustrated by a dashed line 6 in the drawing. As this is a common expedient well known in the automotive art, the engine has not been shown in the interest of reducing drawing complexity.

The novel ignition system of this invention is compatible with any ignition signal pulse generating arrangement. Therefore, it is to be specifically understood that alternate methods for producing the ignition signal pulses in synchronism with the engine may also be employed. For example, a photo-electric pulse generator or conventional mechanically operated ignition breaker points may be substituted for the magnetic pulse generator without departing from the spirit of the invention.

The ignition signal pulses induced in pickup coil 7 may be amplified by a type PNP transistor 20 having the usual base 21, emitter 22 and collector 23 electrodes.

To produce the two trigger signals which are required for the proper operation of the ignition system of this invention, circuitry responsive to the ignition signal pulses is provided. This trigger circuitry includes transistor 30, transistor 40, transistor 50, and capacitors 12 and 14.

To establish the energizing circuit between the ignition system of this invention and the source of system potential 10, a switch 16 which is operable to two positions, is provided. Switch 16 has an input terminal 18 and first and second output terminals 25 and 26. When the movable contact 27 of switch 16 is operated to the first position, an electrical circuit is completed between input terminal 18 and output terminal 25 and when the movable contact 27 is operated to the second position an electrical circuit is completed between input terminal 18 and output terminals 25 and 26. Switch 16 may be a conventional automobile ignition switch which has a cranking position, corresponding to the second position, and a running position, corresponding to the first position. Input terminal 18 is connected to the positive polarity terminal of battery 10 through lead 34.

A converter circuit which includes a transformer 44 having a primary winding 45, a secondary winding 46 and a feedback winding 47, a diode bridge 56 having input circuit terminals 57 and 58 and output circuit terminals 59 and 60, and a type NPN transistor 70 having the usual base 71, emitter 72 and collector 73 electrodes, is also provided. This converter circuit inverts the direct current potential of the system potential source 10, transforms the inverted potential to a potential of a higher magnitude and rectifies the potential of a higher magnitude for charging storage capacitor 62 in response to one of the trigger signals produced by the trigger signal circuitry when switch 16 is operated to the first position and continuously when switch 16 is operated to the second position, in a manner to be later explained.

This converter circuit and switch 16 is connected across potential source 10 through lead 34, leads 36, 38 and 66 and point of reference potential 5.

Storage capacitor 62 and the primary winding 77 of ignition coil 76 are connected in series with the converter circuit output circuit terminals 59 and 60 of diode bridge 56 through resistor 80, lead 81 and lead 82, point of reference potential 5 and lead 68. The circuit just described is the charging circuit for storage capacitor 62.

To complete a discharge circuit for capacitor 62 through the primary winding 77 of ignition coil 76 when it is desired to fire a spark plug of the engine, a controllable switching device of the type which is responsive to the other one of the trigger signals produced by the trigger circuitry previously described is connected in shunt with

storage capacitor 62 and the primary winding 77 of ignition coil 76. The controllable switching device has been shown in the figure as a silicon controlled rectifier 84 which is connected in shunt across storage capacitor 62 and primary winding 77 through lead 86 and diode 87, lead 88 and point of reference potential 5.

With the movable contact 27 of switch 16 closed between input terminal 18 and output terminal 25, a circuit is completed from battery 10 to line 36 and, therefore, full battery potential appears between line 36 and point of reference potential 5.

The emitter electrode 22 of transistor 20 is connected to line 36 through an inductor 90 and lead 91 and the collector electrode 23 is connected to point of reference potential 5 through lead 92 and resistors 93 and 94. With battery 10 poled as shown, the emitter-collector electrodes of type PNP transistor 20 are forward poled. The base electrode 21 of transistor 20 is connected to the emitter electrode 22 thereof through resistor 96, pickup coil 7 of the magnetic pulse generator and lead 98. In the absence of a signal in pickup coil 7, therefore, the emitter electrode 22 and base electrode 21 of transistor 20 are at substantially the same potential, therefore, transistor 20 is normally not conducting. To reduce the possibility of transistor 20 becoming conductive in response to spurious signals which may appear in the system, a slight reverse base bias is applied to the base electrode 21 thereof through resistor 100 which is returned to the positive polarity potential line 36 through lead 91.

The collector electrodes 33 of transistor 30 is connected to the positive polarity potential line 36 through lead 102, resistor 104, inductor 90 and lead 91, while the emitter electrode 32 thereof is connected to point of reference potential 5 through lead 106. Therefore, the emitter-collector electrode circuit of type NPN transistor 30 is forward poled. The base electrode 31 of transistor 30 is connected to junction 108 between resistors 93 and 94. With transistor 30 not conducting, the base and emitter electrodes of transistor 30 are at substantially the same potential, therefore, transistor 30 is normally not conducting.

The collector electrode 43 of type NPN transistor 40 is connected to the positive polarity potential line 36 through resistor 110, line 112, inductor 90 and lead 91 while the emitter electrode 42 thereof is connected to point of reference potential 5 through lead 114. Therefore, the emitter-collector electrode circuit of type NPN transistor 40 is forward poled. The base electrode 41 of transistor 40 is connected to the positive polarity potential line 36 through resistor 116 and lead 91 which forward biases type NPN transistor 40. Therefore, transistor 40 is normally conducting.

The collector electrode 53 of type NPN transistor 50 is connected to the positive polarity potential line 36 through resistor 118, line 120 and lead 91 while the emitter electrode 52 thereof is connected to point of reference potential 5 through lead 122. Therefore, the emitter-collector electrode circuit of type NPN transistor 50 is forward poled. The base electrode 51 of transistor 50 is connected to the positive polarity potential line 36 through resistor 124, line 120 and line 91 which forward biases transistor 50. Therefore, transistor 50 is normally conducting.

The collector electrode 73 of type NPN transistor 70 of the converter circuitry is connected to the positive polarity potential line 36 through primary winding 45 of transformer 44 while the emitter electrode 72 thereof is connected to point of reference potential 5 through lead 66, therefore, the emitter-collector electrode circuit of type NPN transistor 70 is forward poled. The base electrode 71 of transistor 70 is connected to output terminal 26 of switch 16 through resistor 126 and line 38 and to point of reference potential 5 through feedback winding 47 of transformer 44 and resistor 128. With the movable contact 27 of switch 16 closed to output

terminal 25, the base and emitter electrodes of transistor 70 are at substantially the same potential, therefore, transistor 70 is normally not conducting.

The positive polarity potential output circuit of the converter circuitry is output terminal 60 of diode bridge 56. Therefore, junction 130 and line 81 are of a positive polarity. The anode electrode of silicon controlled rectifier 84 is connected to positive polarity junction 130 through lead 86 and the cathode electrode thereof is connected to the negative polarity output terminal of the converter circuitry, output terminal 59 of the bridge rectifier circuit 56, through diode 87, lead 88, point of reference potential 5 and lead 68. Therefore, the anode-cathode circuit of this device is forward poled. Forward poled silicon controlled rectifier devices may be triggered to conduction by the application to the control electrode thereof of a potential signal of a polarity more positive than the potential applied to the cathode electrode thereof and will continue conducting until the anode-cathode circuit is interrupted or the polarities thereof reversed.

As transistor 40 is normally conducting, the potential appearing at junction 132 is substantially ground potential, being positive only to the extent of the collector-emitter drop through conducting transistor 40. As junction 132 is connected to the control electrode of silicon controlled rectifier device 84 through diode 134 and line 136, this potential is not of a sufficient positive polarity magnitude to trigger silicon controlled rectifier 84 to conduction through diode 134 and across resistor 138. However, with transistor 40 conducting, a charging circuit for capacitor 14 may be traced from positive polarity potential line 36 through lead 91, inductor 90, resistor 104, capacitor 14, the base emitter circuit of conducting transistor 40, lead 114 and point of reference potential 5.

With transistor 50 conducting, the potential appearing at junction 140 is substantially ground potential, being positive only to the extent of the collector-emitter drop through conducting transistor 50. This potential is not of sufficient magnitude to forward bias transistor 70 through diode 142. With transistor 50 conducting, a charging circuit for capacitor 12 may be traced from positive polarity potential line 36 through lead 91, inductor 90, resistor 104, capacitor 12, the base-emitter circuit of transistor 50, line 122 and point of reference potential 5.

With movable contact 27 of switch 16 operated to the position which closes an electrical circuit between input terminal 18 and output terminals 25 and 26 thereof, substantially full system supply potential appears between lines 36 and 38 and point of reference potential 5. With switch 16 operated to this position, the starting motor energizing solenoid 181, which is connected between line 38 and point of reference potential 5, is energized. The energized starting motor begins to crank the engine which, in turn, drives distributor shaft 6 and the magnetic rotor 9 of the magnetic pulse generator.

As the movable contact of switch 16 is operated to connect input terminal 18 and output terminal 26, the potential appearing across positive polarity potential line 38 and point of reference potential 5 produces a flow of current through resistor 126, feedback winding 47 and resistor 128. As the impedance of feedback winding 47 is high with the initial current flow therethrough, current also flows through the base-emitter circuit of the type NPN resistor 70 which triggers this device to conduction.

As transistor 70 conducts, an energizing circuit for the primary winding 45 of transformer 44 is established and current flows from positive potential line 36 through primary winding 45, conducting transistor 70, line 66, and point of reference potential 5 to battery 10. This current flow induces a potential of a higher magnitude in secondary winding 46 of transformer 44 and this potential of a higher magnitude is rectified by the diode bridge rectifier circuit 56 and appears across output terminals 59 and 60 thereof. As storage capacitor 62 is connected across output terminals 59 and 60 by a circuit previously described,

this rectified potential of a higher magnitude begins charging storage capacitor 62. A potential is also induced in feedback winding 47 which is so polarized that the potential appearing at junction 146 is of a potential more positive than that appearing at junction 148 when battery 10 is energizing primary winding 45.

The current flow through the primary winding 45 of transformer 44 increases until the iron of the core saturates and the impedance of feedback winding 47 and primary winding 45 decreases. The base current flow through transistor 70 is insufficient to sustain the resulting increased collector current, therefore, transistor 70 becomes non-conductive.

As transistor 70 becomes non-conductive, the energizing circuit from primary winding 45 of transformer 44 is interrupted. The interruption of the energizing circuit causes the magnetic field to collapse which induces a potential in primary winding 45, in feedback winding 47 and in secondary winding 46.

The potential induced in primary winding 45 is more positive at junction 150 than it is at junction 152 and produces a current flow through Zener diode 154 and blocking diode 156. The amplitude of this potential is limited by the rated breakdown potential of Zener diode 154 and the forward drop across blocking diode 156 and remains substantially independent of battery 10 potential changes.

The polarity of the potential induced in feedback winding 47 is more positive at junction 148 than at junction 146. As this winding is connected between the base and emitter electrodes of transistor 70, this induced potential reverse base biases transistor 70 and holds it off for a period of time long enough to permit the field of transformer 44 to substantially completely collapse.

The potential induced in secondary winding 46 is, of course, rectified by diode bridge rectifier 56 and adds an additional charge to storage capacitor 62.

When the energy which has been induced in feedback winding 47 has dissipated through diode 158 and resistor 128, the current flow from positive polarity potential line 38, resistor 126 and the base-emitter circuit of transistor 70 triggers transistor 70 to conduction, thereby re-establishing the energizing circuit for primary winding 45 of transformer 44 between positive polarity potential line 36 and point of reference potential 5.

The cycle just described repeats itself to continuously oscillate and establish and interrupt the energizing circuit for primary winding 45 of transformer 44.

When the starting motor rotates the engine and rotor 9, an ignition signal pulse is induced in pickup coil 7, which is so polarized that junction 160 is more positive than junction 162 when the teeth of rotor 9 are approaching alignment with pole piece 8. This induced ignition signal pulse is applied across the base 21 and emitter 22 electrodes of type PNP transistor 20 and is of the correct polarity to produce emitter-base current therethrough which triggers transistor 20 to conduction. With transistor 20 conducting, current flows from positive polarity potential line 36 through lead 91, inductor 90, the emitter-collector circuit of transistor 20, resistors 93 and 94 and point of reference potential 5 to the negative polarity terminal of battery 10. The potential appearing at junction 108 as a result of this current flowing through resistor 94 is of a positive polarity and is applied to the base electrode 31 of type NPN transistor 30. This potential is of the proper polarity to produce base-emitter current flow through transistor 30 thereby triggering this device to conduction.

With transistor 30 conducting, current flows from positive polarity potential line 36, lead 91, inductor 90, resistor 104, the collector-emitter circuit of transistor 30, lead 106 and point of reference potential 5 to the negative polarity terminal of battery 10. A current also flows through the emitter-base circuit of transistor 20, resistor 164 and the collector-emitter circuit of transistor 30.

This current and the current from pickup coil 7 holds these two transistors conducting until they are turned off by the polarity reversal of the potential induced in pickup coil 7 of the magnetic pulse generator as a tooth on rotor 9 moves away from the pole tips of pole piece 8.

Conducting transistor 30 also establishes a discharge path for capacitors 12 and 14 which, in discharging, triggers respective normally conducting transistors 50 and 40 to non-conduction.

When transistor 50 does non-conductive, the slightly positive polarity potential appearing at junction 140 increases and establishes a flow of current through diode 142 and the base-emitter electrodes of transistor 70 triggering this device to conduction.

When transistor 40 goes non-conductive, the slightly positive polarity potential appearing at junction 132 increases and current flows through diode 134 and resistor 138 producing a potential drop thereacross which is applied to the control electrode 85 of silicon controlled rectifier 84 triggering this device to conduction and establishing the discharge circuit for storage capacitor 62 through the primary winding 77 of ignition coil 76.

The extinguishing of conducting transistors 50 and 40, therefore, produces the two trigger signals which are required to trigger transistor 70 and silicon controlled rectifier 84 to conduction.

The voltage applied across primary winding 77 of ignition coil 76 is of such a polarity that junction 166 is of a negative polarity in respect to ground. This potential is transformed and appears in secondary winding 78 as a potential of sufficient magnitude to fire a spark plug. As this is a common expedient well known in the art, in the interest of reducing drawing complexity, only one of the spark plugs has been schematically represented and referenced by the numeral 103.

The inductance-capacitance combination of storage capacitor 62 and primary winding 77 produces an oscillation of primary potential such that the polarity of the potential of junction 168 becomes negative in respect to ground and current flows through winding 77, point of reference potential 5, diode 170 in series with inductor 172 and storage capacitor 62. This current reverses the bias potential across silicon controlled rectifier 84, therefore, this device goes non-conductive. Inductor 172 is inserted in series in this circuit to decrease the turn off current buildup and to reduce the positive rate of potential rise at point 168 with respect to point of reference potential 5. Diode 87 blocks this turn off current from silicon controlled rectifier 84.

Transistor 40 is held non-conductive for a period of time as determined by the time constant of resistor 116 and capacitor 14, thereby holding the forward bias potential upon the control electrode of silicon controlled rectifier 84.

Transistor 50 is held non-conductive for a period of time as determined by the time constant of resistor 124 and capacitor 12 thereby maintaining the forward base bias potential upon the base electrode 71 of transistor 70 for a sufficient length of time to permit substantially complete buildup of energizing current through primary winding 45 of transformer 44.

When capacitors 12 and 14 have become discharged, the reverse base bias potential is removed from respective transistors 50 and 40 and, therefore, these devices again begin to conduct, removing the trigger signals from the base 71 of transistor 70 and from the control electrode 85 of silicon controlled rectifier 84.

As the engine continues to rotate, the teeth of rotor 9 of the magnetic pulse generator which produced the positive polarity signal pulse in pickup coil 7 begins to move away from the pole tips of pole piece 8 thereby inducing a potential in pickup coil 7 which is of a positive polarity at junction 162 in respect to junction 160, a condition which reverse base biases type PNP transistor 20, thereby triggering this device non-conductive. With tran-

sistor 20 no longer conducting, the forward bias appearing at junction 168 is removed from the base electrode 31 of transistor 30 and, therefore, transistor 30 goes non-conductive. Capacitors 12 and 14 then charge through inductor 90, resistor 104 and the respective base-emitter junctions of transistors 50 and 40.

When the next pair of teeth of rotor 9 of the magnetic pulse generator approach the corresponding pole tips of pole piece 8, the signal pulse, which is more positive at junction 160 in respect to junction 162, is induced in pickup coil 7 and the cycle just described is repeated. The switching of transistor 50 has no substantial effect on transistor 70 at this time as transistor 70 is continuously oscillating.

After the engine has started, the movable contact 27 of switch 16 is operated to complete a circuit between input terminal 18 and output terminal 25. In this position, the circuit including resistor 126 is no longer energized and, therefore, transistor 70 is responsive only to the trigger signals applied to its base 71 from junction 140 through diode 142 as transistor 50 goes non-conductive in a manner as previously described. With switch 16 in this position, transistor 70 and silicon controlled rectifier 84 are substantially simultaneously triggered to conduction by the trigger signals produced by respective transistors 50 and 40 and ignition of a spark plug occurs.

From this description, it is apparent that with movable contact 27 of switch 16 closed between input terminal 18 and output terminals 25 and 26, transistor 70, transformer 44, feedback winding 47 and the circuit including resistor 126 are interconnected relative to the power source in such a manner that the converter circuit oscillates to trigger transistor 70 conductive and non-conductive for establishing and interrupting an energizing circuit for primary winding 45 of transformer 44. This action inverts the direct current potential of source 10 to an alternating current potential through the transformer as the magnetic field produced by current flow through primary winding 45 builds up and collapses as transistor 70 is conductive and not conductive. This alternating current potential is transformed through the transformer and appears as potential of a higher magnitude in secondary winding 46 which is full wave rectified by diode bridge rectifier 56.

With movable contact 27 of switch device 16 closed between input 18 and output terminal 25, switch 16, and the converter circuitry are interconnected in such a manner that transistor 70 operates to establish and interrupt the energizing circuit for transformer primary winding 45 in response to a trigger signal produced as transistor 50 goes non-conductive in a manner previously explained.

The converter circuitry, when in the oscillator mode, oscillates at a frequency primarily dependent upon the magnitude of potential of battery 10 while the engine is being cranked. This oscillatory action pumps energy into storage capacitor 62 until a steady state potential is reached due to the fact that Zener diode 154 and diode 156 holds the induced potential across winding 45 constant. Under normal engine running conditions, transistor 70 switches at a rate proportional to engine speed, sufficient energy being stored in capacitor 62 during each ignition period.

Inductor 90 decouples the trigger circuit network of pickup coil 7 and transistor 20 from transient supply line potentials. Capacitors 174, 176 and 178 suppress high frequency which may be generated within the ignition system. Resistor 96 prevents damage to transistor 20 in the event one of the leads should become accidentally grounded. Resistor 183 drains the charge from storage capacitor 62 when the engine is neither being cranked nor running.

Throughout this specification specific transistor types and electrical polarities have been set forth. It is to be

specifically understood that alternate transistor types, properly poled, may be substituted therefor.

While a preferred embodiment of the present invention has been shown and described, it will be obvious to those skilled in the art that various modifications and substitutions may be made without departing from the spirit of the invention which is to be limited only within the scope of the appended claims.

What is claimed is as follows:

1. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, converter circuit means including output circuit means for inverting the direct current potential of said potential source, transforming said inverted potential to a potential of a higher magnitude and rectifying said potential of a higher magnitude in response to either one of said first and second trigger signals when said engine is running normally and continuously when said engine is being cranked, means for connecting said converter circuit means across said potential source, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said converter circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

2. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device operable to a first and a second position, converter circuit means including output circuit means for inverting the direct current potential of said potential source, transforming said inverted potential to a potential of a higher magnitude and rectifying said potential of a higher magnitude in response to either one of said first and second trigger signals when said switch device is operated to either one of said first and second positions and continuously when said switch device is operated to the other one of said positions, means for connecting said switch device and said converter circuit means across said potential source, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said converter circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

3. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means for amplifying said ignition signal pulses, means responsive to said amplified ignition signal pulses for producing a first and a second trigger signal, a switch device operable to a first and a second position, converter circuit means including output circuit means, a semi-conductor device, a transformer and a rectifier circuit for inverting the direct current potential of said potential source, transforming said inverted potential to a potential of a higher magnitude and rectifying said potential of a higher magnitude, means for interconnecting said potential source, said switch device and said converter circuit in such a manner that said semi-conductor device operates to interrupt an energizing circuit for said transformer in response to

either one of said first and second trigger signals when said switch device is operated to either one of said positions and operates in cooperation with said transformer as an oscillator to interrupt an energizing circuit for said transformer continuously when said switch device is operated to the other one of said positions, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said converter circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor device through said ignition coil primary winding.

4. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, means for connecting said input terminal to a selected polarity terminal of said potential source, converter circuit means including output circuit means connected between said first and second output terminals of said switch device and the opposite polarity terminal of said potential source for inverting the direct current potential of said potential source, transforming said inverted potential to a potential of a higher magnitude and rectifying said potential of a higher magnitude in response to a selected one of said first and second trigger signals when said switch device is operated to said first position and continuously when said switch device is operated to said second position, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said converter circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

5. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, a trigger signal controllable switching device having two current carrying electrodes and a control electrode of the type which may be rendered conductive only during the presence of a control signal of proper polarity upon said control electrode, means for connecting said input terminal and said first output terminal of said switch device, said transformer primary winding and said current carrying electrodes in series across said potential source, means for connecting said feedback winding across said control electrode and one of said current carrying electrodes, means for applying either one of said first and second trigger signals to said control electrode, a resistor connected between said second output terminal of said switch device and said control electrode, a rectifier circuit having input and output circuit means, means

for connecting said rectifier circuit input circuit means across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said rectifier circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

6. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, semi-conductor switching device having two current carrying electrodes and a control electrode of the type which may be rendered conductive only during the presence of a control signal of proper polarity upon said control electrode, means for connecting said input terminal and said first output terminal of said switch device, said transformer primary winding and said current carrying electrodes in series across said potential source, means for connecting said feedback winding across said control electrode and one of said current carrying electrodes, means for applying either one of said first and second trigger signals to said control electrode, a resistor connected between said second output terminal of said switch device and said control electrode, a rectifier circuit having input and output circuit means, means for connecting said rectifier circuit input circuit means across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said rectifier circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

7. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, transistor switching device having base, emitter and collector electrodes, means for connecting said input terminal and said first output terminal of said switch device, said transformer primary winding and said emitter and collector electrodes in series across said potential source in such a manner that said transistor switching device is forward poled, means for connecting said feedback winding across said base electrode and either one of said emitter and collector electrodes, means for applying either one of said first and second trigger signals to said base electrode, a resistor connected between said second output terminal of said switch device and said base electrode, a rectifier circuit having input

and output circuit means, means for connecting said rectifier circuit input circuit means across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said rectifier circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

8. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, a transistor switching device having base, emitter and collector electrodes for establishing and interrupting an energizing circuit for said transformer primary winding, means for connecting said input terminal and said first output terminal of said switch device, said transformer primary winding and said emitter and collector electrodes in series across said potential source in such a manner that said transistor switching device is forward poled, means for connecting said feedback winding across said base electrode and either one of said emitter and collector electrodes and poled in such a manner that the potential induced therein is of a direction to forward base bias said transistor switching device when said transformer primary winding is energized by said potential source, means for applying either one of said first and second trigger signals to said base electrode, a resistor connected between said second output terminal of said switch device and said base electrode, rectifier circuit having input and output circuit means, means for connecting said rectifier circuit input circuit means across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said rectifier circuit output circuit, means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

9. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, a transistor switching device having base, emitter and collector electrodes for establishing and interrupting an energizing circuit for said transformer primary winding, means for connecting said input terminal and said first output terminal of said switch device, said transformer primary winding and a selected two of said electrodes of said transistor switching device in series across said potential source, means for connecting said feedback winding across said third electrode and either

one of said selected two electrodes and poled in such a manner that the potential induced therein is of a direction to forward bias said transistor switching device when said transformer primary winding is energized by said potential source, means for applying either one of said first and second trigger signals to said third electrode, a resistor connected between said second output terminal of said switch device and said third electrode, a rectifier circuit having input and output circuit means, means for connecting said rectifier circuit input circuit means across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series with said rectifier circuit output circuit means for charging said capacitor and means responsive to the other one of said trigger signals for completing a discharge circuit for said capacitor through said ignition coil primary winding.

10. A capacitor discharge ignition system for an internal combustion engine comprising in combination with a direct current potential source having positive and negative polarity terminals, a magnetic pulse generator means for producing ignition signal pulses in synchronism with said engine, means responsive to said ignition signal pulses for producing a first and a second trigger signal, a switch device having an input terminal and first and second output terminals of the type which is operable to a first position and a second position for completing an electrical circuit between said input terminal and said first output terminal and between said input terminal and said first and second output terminals, respectively, a transformer having a primary winding, a secondary winding and a feedback winding, a transistor switching device having base, emitter and collector electrodes for establishing and interrupting an energizing circuit for said transformer primary winding, means for connecting said input terminal of said switch device to said positive polarity terminal of said potential source, means for connecting said transformer primary winding and said collector and emitter electrodes of said transistor switching device in series between said first output terminal of said switch device and said negative polarity terminal of said potential source, means for connecting said feedback winding across said base electrode and said emitter electrode and poled in such a manner that the potential induced therein is of a direction to forward base bias said transistor switching device when said transformer primary winding is energized by said potential source, means for applying either one of said first and second trigger signals to said base electrode of said transistor switching device, a resistor connected between said second output terminal of said switch device and said base electrode of said transistor switching device, a full wave rectifier circuit having input and output terminals, means for connecting said rectifier circuit input terminals across said transformer secondary winding, a capacitor, an ignition coil having a primary winding and a secondary winding, means for connecting said capacitor and said ignition coil primary winding in series across said rectifier circuit output terminals for charging said capacitor and a silicon controlled rectifier switching device responsive to the other one of said trigger signals connected in shunt across said capacitor and said ignition coil primary winding for completing a discharge circuit for said capacitor device through said ignition coil primary winding.

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