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Burkett et al.

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[54] **CAPACITOR DISCHARGE IGNITION SYSTEM**

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[52] **U.S. Cl.** ..... **123/148 E**; 315/209

[51] **Int. Cl.** **F02p 3/06**

[58] **Field of Search** ..... 123/148, 149; 307/252 L, 307/252 M, 252 N; 315/209 CD, 209 SC

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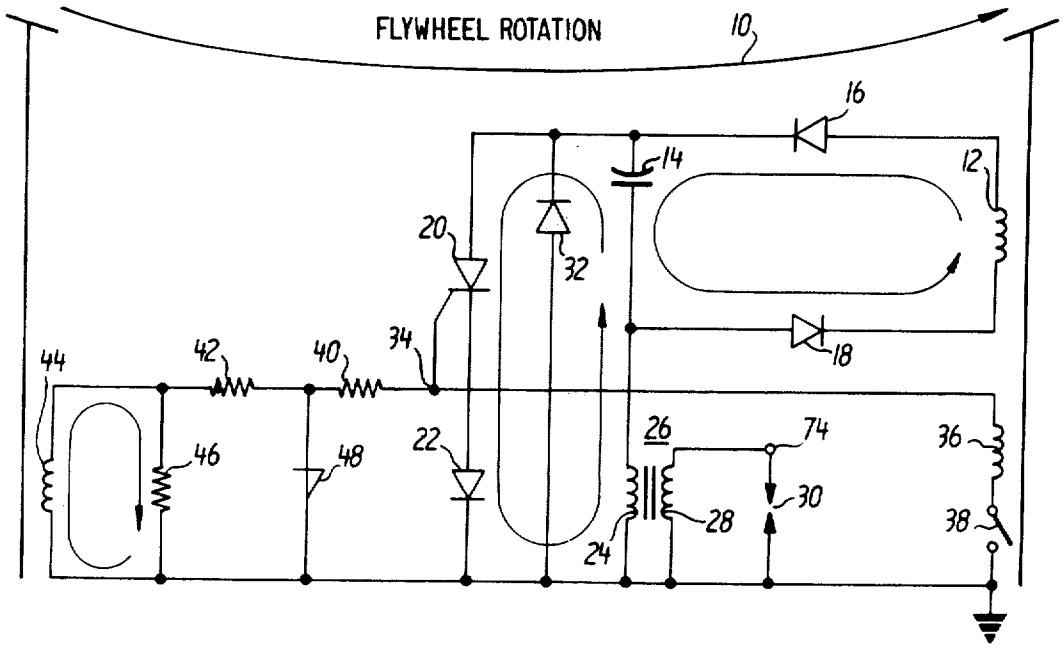
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[57] **ABSTRACT**

A capacitor discharge ignition system in which shut-off of the electronic switch is ensured by the use of an impedance means in series between the electronic switch and the primary winding of the ignition transformer, and by the use of a voltage responsive device to remove the triggering potential from the electronic switch immediately after the conduction of the electronic switch. Engine shut-off is ensured by the application of triggering potential to the electronic switch concurrently with the application of charging current to the ignition capacitor whereby the electronic switch remains conductive to prevent the accumulation of a charge on the ignition capacitor. A novel two-legged core and physical arrangement of the coils and other components of the system is also disclosed for one and multiple cylinder operation.

21 Claims, 7 Drawing Figures



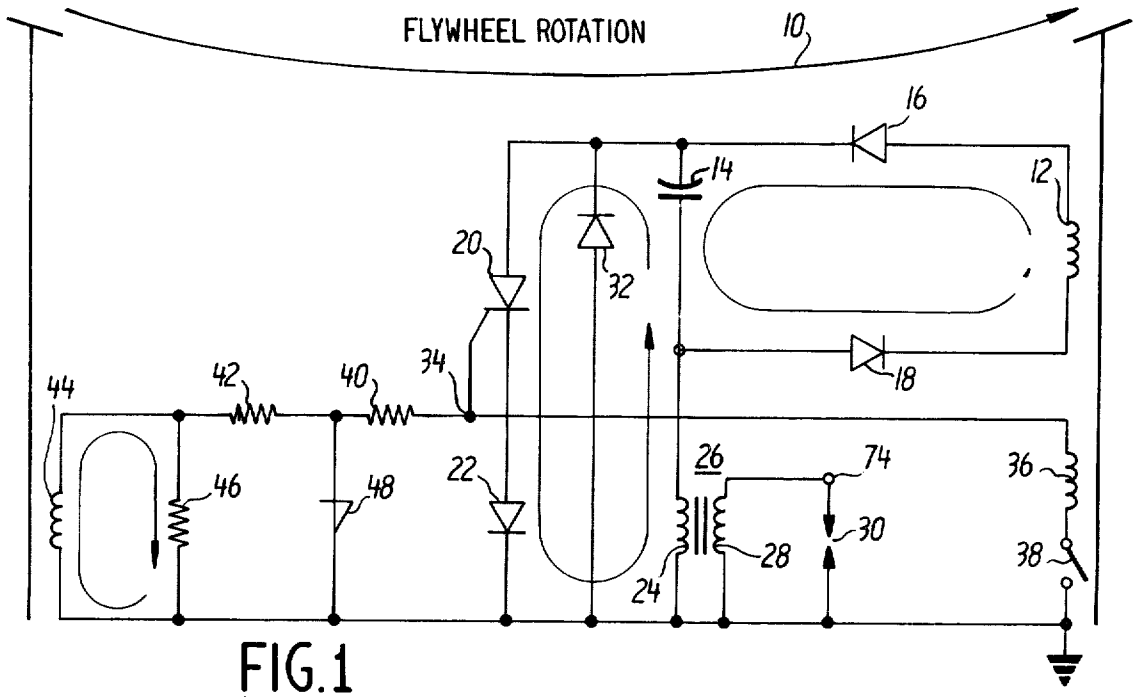


FIG.1

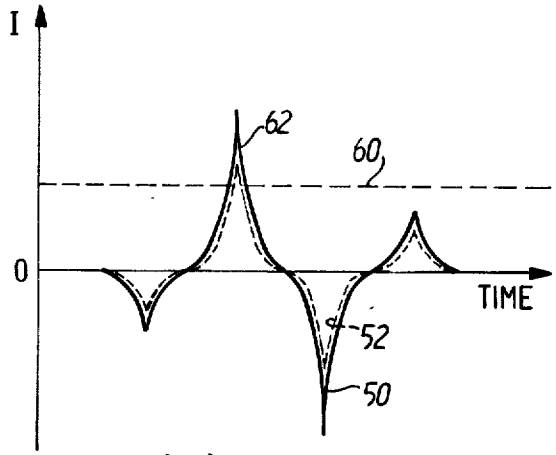


FIG.2(A)

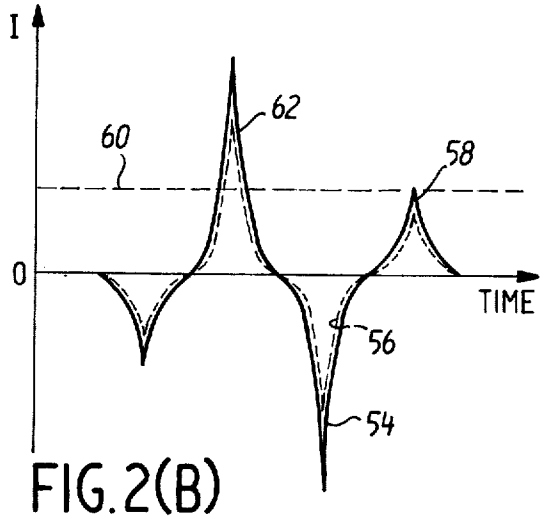
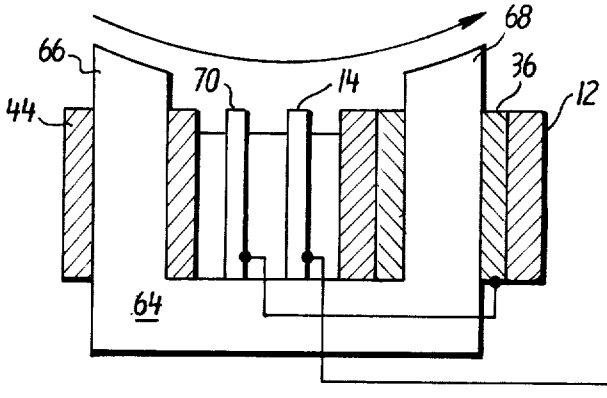


FIG.2(B)



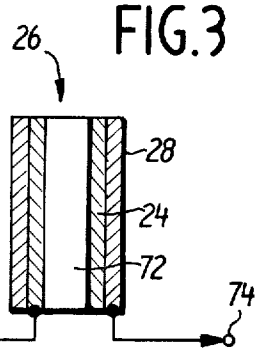


FIG.3

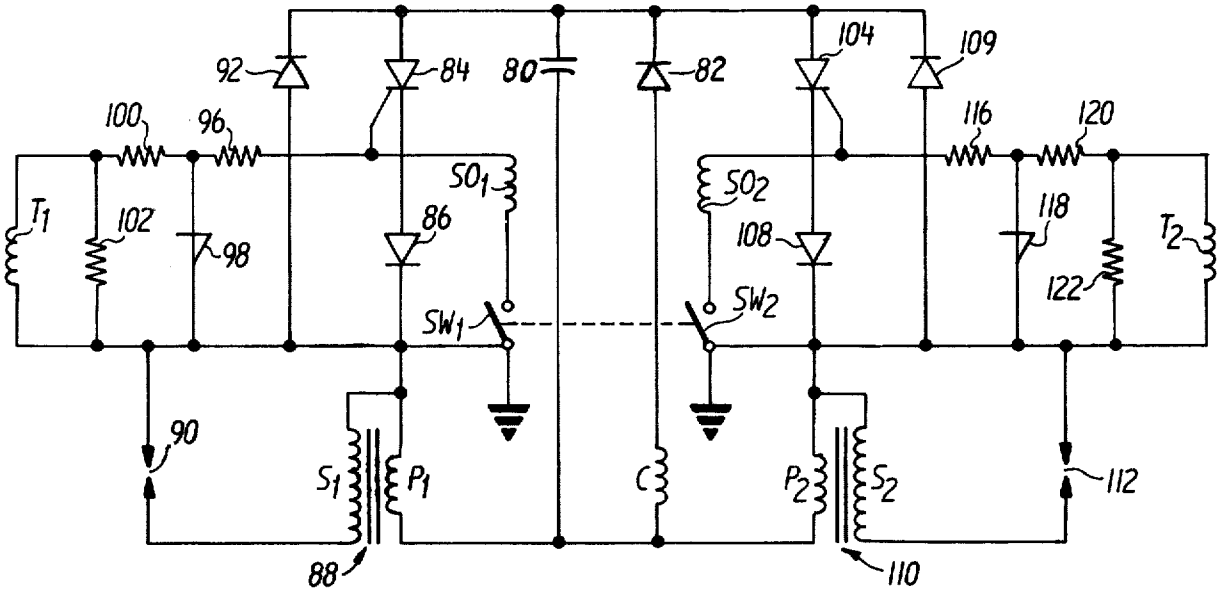


FIG.4

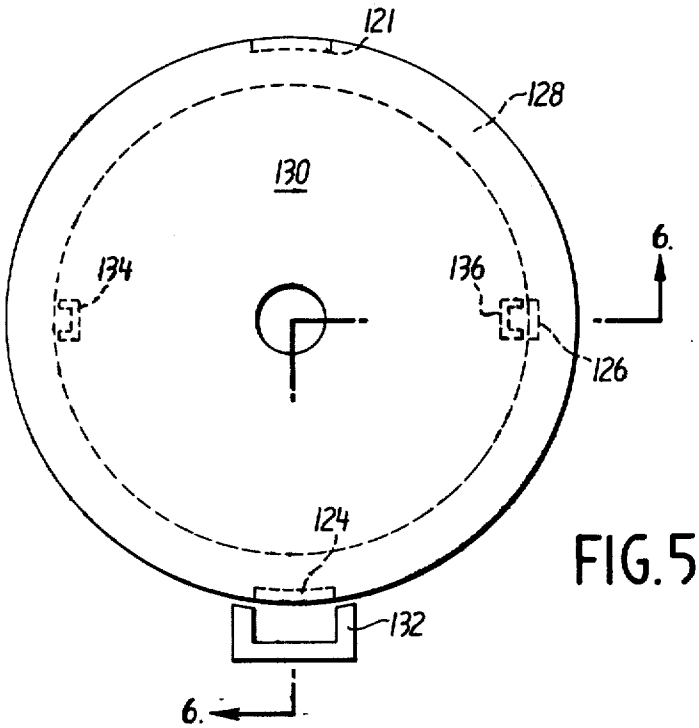


FIG.5

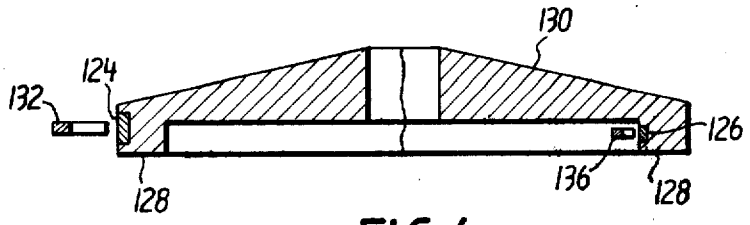


FIG.6

CAPACITOR DISCHARGE IGNITION SYSTEM

BACKGROUND OF THE INVENTION

The present invention relates to capacitor discharge ignition systems and more specifically to an ignition system and method having novel electronic switch shutoff and engine shutoff features.

Capacitor discharge ignition systems are well known. Such systems generally utilize the rotation of a magneto in flux cutting proximity to induce a current in the charging coil of the capacitor and the subsequent inducing of a trigger current by continued magneto rotation in a trigger coil connected to the gate or trigger electrode of the electronic switch. The electronic switch traditionally employed has been a silicon controlled rectifier (SCR) which conducts in a single direction respectively to a predetermined anode-cathode bias and the application of a triggering pulse to the gate thereof. It is a characteristic of SCRs that conduction, once commenced, continues so long as the necessary anode-cathode bias is present irrespective of the continued presence of the triggering pulse. Shutoff of the SCR is thus achieved by the loss of the necessary anode-cathode potential as the capacitor discharges rather than by the loss of triggering potential on the gate of the SCR.

A continuing problem in the utilization of electronic switches such as SCRs in capacitor discharge ignition circuits lies in the substantially continuous conduction thereof due to the continued presence of a triggering potential on the gate electrode as the charging current reestablishes the necessary anode-cathode bias. The substantial continuous conduction of the SCR thus distributes the energy of the charging current over a time interval sufficient to reduce the amplitude below that which is required for ignition. Cutoff of the SCR between the discharge of the capacitor and the generation of a subsequent charging current is thus necessary.

It is accordingly an object of the present invention to obviate this and other deficiencies of the known prior art capacitor discharge ignition systems and to provide a novel method and system for the ignition control of an internal combustion engine.

Another object of the present invention is to provide a novel method and system for insuring the nonconduction of an SCR in a capacitor discharge ignition system between the charging cycles of the capacitor.

Still another object of the present invention is to provide a novel method and system for the timely removal of triggering potential from the gate of an SCR in a capacitor discharge ignition system.

Yet still another object of the present invention is to provide a novel method and system for delaying the achievement of an anode-cathode bias sufficient for the conduction of an SCR in a capacitor discharge ignition system.

A further object of the present invention is to provide a novel method and system for insuring engine cutoff by insuring the continued conduction of the electronic switch in the capacitor discharge ignition system.

A still further object of the present invention is to provide a novel physical arrangement of a two-legged core and ignition circuit components whereby a significant reduction in size and weight may be achieved.

Yet a further object of the present invention is to provide a novel method and system for component sharing in a plural cylinder capacitor discharge ignition system.

Yet still a further object of the present invention is to provide a novel physical arrangement of components for a plural cylinder capacitor discharge ignition system.

These and many other objects of the present invention will become apparent to one skilled in the art to which the invention pertains from a perusal of the following detailed description when read in conjunction with the appended drawings.

THE DRAWINGS

FIG. **1** is a schematic circuit diagram of the circuit of the present invention;

FIGS. **2A** and **2B** are waveforms of the current induced in the trigger coil at different engine speeds;

FIG. **3** is a pictorial elevation in partial section illustrating the physical configuration of the system;

FIG. **4** is a schematic circuit diagram of the circuit of the present invention for a two-cylinder engine;

FIG. **5** is a schematic top plan view illustrating the physical arrangement of the coil systems and flywheel magnets; and,

FIG. **6** is a section in elevation taken through lines **6—6** of FIG. **5.**

THE DETAILED DESCRIPTION

With reference now to FIG. **1** wherein the circuit of the present invention is schematically illustrated, a suitable conventional magneto or magnet carrying flywheel may be rotated in a counterclockwise direction as illustrated by the arrow **10.** A coil **12** may be disposed in flux cutting proximity to the magneto and may be connected to a capacitor **14** by means of diodes **16** and **18.** The capacitor **14** may also be connected in series circuit with a suitable conventional electronic switch such as an SCR **20,** a diode **22** and the primary winding **24** of a high voltage transformer **26.** The secondary winding **28** of the high voltage transformer **26** may be connected through a suitable conventional distributor (not shown) to one or more gap ignition devices such as the illustrated spark plug **30.** The SCR **20** and the diode **22** may be connected in parallel with a diode **32.**

The coil **12** of the circuit as above described provides a charging current to the capacitor **14** through the diodes **16** and **18.** It is to be understood that the number of diodes in the charging circuit may vary so long as they are collectively sufficient in voltage rating to withstand the high reverse bias occasioned by the charge coil **12** as will be subsequently explained. The diode **32** must have a voltage rating sufficient to withstand the preignition charge of the capacitor **14** and performs a commutating function as the circuit "rings" with the discharge of the capacitor **14** through the primary winding **24** of the transformer **26.**

The trigger electrode or gate **34** of the SCR **20** may be connected to one end of a coil **36** also disposed in flux cutting proximity to the path **10** of the magneto. The coil **36** may be disposed in substantially the same spatial relationship with the magneto as is the coil **12** and the other end of the coil **36** may be selectively grounded through the operation of a suitable conventional electronic or manually operable switch **38.**

The gate **34** of the SCR **20** may be connected in series with a pair of resistors **40** and **42** to one end of a coil **44** disposed in flux cutting proximity to the path **10** of the magneto. As will be explained later in greater de-

tail, the coil **44** precedes the coils **12** and **36** in the direction of rotation of the magneto. The coil **44** may be connected in parallel with a resistor **46** and the resistor **40**-resistor **42** junction grounded through a voltage responsive device such as the illustrated breakdown diode **48**.

In operation with the switch **38** in the illustrated open position and the SCR **20** nonconducting, the rotation of the flywheel magnet in flux cutting proximity to the coils **12** and **36** induces a current in the coil **12** but not in the coil **36** due to the open circuit provided by the switch **38**. The current induced in the coil **12** is passed through the diodes **16** and **18** to charge the capacitor **14**. The polarity of the diode **32** and the nonconducting condition of the SCR **20** insure the lack of a discharge path for the capacitor **14** during the charging thereof with the current induced in the charging coil **12**.

Continued rotation of the magneto will result in the rotation of the magnet carried thereby past the trigger coil **44** in flux cutting proximity thereto. The current thus induced in the trigger coil **44** passes through the resistor **46** to produce a voltage drop thereacross. This voltage drop also appears across the resistor **42** and the breakdown diode **48** which together act as a voltage divider to provide a positive potential at the resistor **40**-resistor **42** junction and thus the gate **34** of the SCR **20**.

When the potential on the gate **34** of the SCR **20** increases sufficiently with respect to the cathode thereof, the SCR **20** conducts due to the positive anode-to-cathode bias provided by the charge on the capacitor **14** and the capacitor **14** is discharged through the SCR **20**, the diode **22** and the primary winding **24** of the high voltage transformer **26**. The current induced in the secondary winding **28** of the high voltage transformer **26** by the passage of current through the primary winding **24** thereof is applied to the appropriate gap ignition device **30**. Thus the engine responsive rotation of the magneto alternately induces a charging current in the coil **12** to effect the charging of the capacitor **14** and the inducing of a trigger current in the trigger coil **44** to discharge the capacitor **14** through the high voltage transformer **26** by the firing of the SCR **20**.

The resistor **42** limits the current which passes through the breakdown diode **48** upon the breakdown thereof. The resistor **40** performs a similar current limiting function to protect the gate **34** of the SCR **20**.

The resistor **46** helps to prevent an untimely firing of the SCR **20** in that it effects a reduction in the amplitude of the positive current pulse illustrated as waveform **50** in FIG. **2A** to that illustrated in phantom as waveform **52**. There is a similar amplitude reduction from that illustrated as waveform **54** in FIG. **2B** to that illustrated in phantom as waveform **56**.

The difference between the waveforms of FIGS. **2A** and **2B** is primarily one of the speed of rotation of the magneto. As illustrated in FIG. **2B**, the second positive excursion **58** of the current pulse might exceed the trigger level **60** of the SCR **20** and thus produce a misfire. The reduction in amplitude provided by the resistor **46** reduces this possibility at all engine speeds. The first positive excursion **62**, while attenuated, remains sufficient for triggering the SCR **20** at all engine speeds.

An important feature of the present invention is the use of the diode **22** to insure cutoff of the SCR **20** between the inducement of triggering pulses in the trigger coil **44** and charge pulses in the charge coil **12**. The SCR **20** must become nonconducting to eliminate the discharge path for the capacitor **14** since a significant charge must be accumulated on the capacitor **14** to achieve the desired ignition potential.

More specifically, the voltage drop across the diode **22** increases the cathode potential of the SCR **20** and thus increases the potential to which the gate of the SCR **20** must be raised to achieve the gate-cathode bias necessary for SCR conduction.

As earlier explained, the voltage drop across the breakdown diode **48** is substantially that of the gate **34** of the SCR **20** as the triggering potential is being developed across the resistor **46**. The breakdown point of the diode **48** is desirably selected to be slightly in excess of the potential at which the SCR is rendered conductive. In this manner, the SCR **20** will be triggered by the rising gate **34** potential and shortly thereafter the excessive gate potential will be removed by the breakdown of the diode **48**. In this manner, the trigger potential is reduced from the gate **34** of the SCR **20** almost immediately after the conduction of the SCR **20** and the likelihood of SCR cutoff materially increased with the reduction in gate-cathode bias as a result of the discharge of the capacitor **14**. The breakdown diode **48** thus effectively decreases the possibility of gate saturation which would hold the SCR in conduction longer than desired.

Thus, the use of an impedance device such as the diode **22** or a small resistor to raise the cathode potential of the SCR **20** creates a delay in the reestablishment of sufficient gate-cathode bias and thus increases the likelihood that the trigger potential will have been removed from the gate **34**. The diodes **48** and **22** thus operate together to insure SCR cutoff and thus the continued firing of the ignition device **30**.

One way of insuring engine shutdown is the cessation of the application of a gap ionizing potential to the ignition device **30**. This may be accomplished in the present invention by the closure of the switch **38** so that current will be induced in the shutoff coil **36** in substantial coincidence with the generation of the charging current in the charging coil **12**. The coincidence of generation and the same polarity of the two currents may be insured by the configuration and spatial location of the coils **12** and **36** with respect to the path **10** of the magneto.

With the switch **38** closed, the current induced in the shutoff coil **36** is applied across the resistor **40** and the breakdown diode **48** to provide a triggering potential at the gate **34** of the SCR **20** and thereby insure the conduction thereof as soon as the necessary anode-cathode bias has been established by the application of the charging current to the capacitor **14**. A continuous discharge path for the capacitor **14** is thus provided and the buildup of a charge thereon thus prevented. The continuous discharge of the capacitor **14** effectively spreads the charging current over a time interval sufficiently long in duration that gap ionizing potential is not available for the ignition device **30**. Engine shutdown is thus insured.

With reference to the physical structure illustrated in FIG. **3**, a two-legged magnetic core is shown having the trigger coil **44** wound about one leg **66** thereof and the shut-off coil **36** wound about the other leg **68** thereof. The charging coil **12** as illustrated may be wound about the leg **68** of the core **64** in an overlying relationship with the shut-off coil **36**. While it is desirable to wind the charging and shut-off coils **12** and **36** in this fash-

ion, it is to be understood that the two coils may be axially displaced on the leg **68** of the core **64**, or the shut-off coil wound in overlying relationship with the charge coil.

Disposed between the legs **66** and **68** of the magnetic core **64** may be the ignition capacitor **14** and a printed circuit board **70** by which may be carried the other electrical components of the circuit such as the SCR **20**, trigger diode **48**, etc. The capacitor **14** is illustrated as being connected to the primary winding **24** of the transformer **26**. The secondary winding **28** is desirably wound about a cylindrical ferrite core **72** and the primary winding **24** of the transformer **26** is wound in an overlying relationship to the secondary winding **28**. The output signal from the secondary winding **28** may be applied to the ignition device **30** of the circuit of FIG. **1** by way of an output terminal **74**.

The arrangement illustrated in FIG. **3** has been utilized to reduce both the volume and weight of the ignition circuit to about one-fourth to one-third of the volume and weight normally associated with such ignition circuits. By the use of a ferrite core in the transformers, the transformer may be physically displaced from the remainder of the circuit thus enhancing the flexibility in mounting the system. The transformer may be potted with the remainder of the ignition circuit if desired, or potted and mounted as a separate unit.

The circuit of the present invention may also be adapted for multiple cylinder engines, for example and as illustrated in FIG. **4** in the context of a two-cylinder circuit, additional advantages may be achieved through the utilization of a common charging coil C and ignition capacitor **80** in parallel with a common diode **82**. Also in parallel with the ignition capacitor **80** and the charging coil C are the two trigger circuits necessary for two-cylinder operation.

For example and with reference to the left-hand side of FIG. **4**, the capacitor **80** may be connected through an SCR **84** and a diode **86** to the primary winding P_1 of a first cylinder high voltage transformer **88**. The secondary winding S_1 of the high voltage transformer **88** may be connected between the grounded interconnection of the diode **86** with the primary winding P_1 and the ungrounded side of a first cylinder gap ignition device **90**. A diode **92** may be connected in parallel with and in opposition to the conduction polarity of the SCR **84** and diode **86**.

The trigger circuit for the SCR **84** may be identical to the trigger circuit earlier described in connection with FIG. **1** with the trigger electrode of the SCR **84** grounded through the series connection of a first cylinder shut-off coil SO_1 and a switch SW_1. The trigger electrode of the SCR **84** may also be connected through a resistor **96** and a breakdown diode **98** to ground potential. The interconnection of the resistor **96** and the breakdown diode **98** may be connected through a resistor **100** in series with the parallel combination of a resistor **102** and the first cylinder trigger coil T_1.

Similarly and with reference to the right-hand side of FIG. **4**, the ignition capacitor **80** may be connected to the charging coil C through a diode **82** and also to a second SCR **104**, a diode **108** and the primary winding P_2 of a second cylinder high voltage transformer **110**. The grounded interconnection of the diode **108** and the primary winding P_2 may be connected through the secondary winding S_2 of the transformer **110** to the ungrounded side of a second cylinder gap ignition device **112**.

The trigger electrode of the second cylinder SCR **104** may be grounded through the series connection of a second cylinder shut-off coil SO_2 and a switch SW_2. The trigger electrode of the SCR **104** may also be connected through a resistor **116** and a breakdown diode **118** to ground potential and the interconnection of the resistor **116** and the breakdown diode **118** grounded through a resistor **122** and the trigger coil T_2 associated with the second cylinder.

The operation of the shut-off coils SO_1 and SO_2 may insure the conduction of the SCRs **84** and **104** during the attempted charging of the capacitor **80** by the charging coil C in the manner earlier described in connection with FIG. **1**. Thus, the simultaneous operation of the switches SW_1 and SW_2 may be used to insure engine shut-off by preventing the charging of the ignition capacitor **80** to the ignition potential of the gap ignition devices **90** and **112** as earlier described in connection with the circuit of FIG. **1**.

Similarly, as described in connection with the circuit of FIG. **1**, the trigger diodes **98** and **118** insure the reduction of triggering potential to the trigger electrodes of the SCRs **84** and **104** to minimize the possibility of gate saturation causing the conduction thereof in the absence of a new trigger pulse so that the capacitor **80** may be charged anew from the current induced in the charging coil C.

The use of a single charging coil C and capacitor **80** for two cylinders requires the utilization of two flywheel magnets **121** and **124** illustrated schematically in FIG. **5**. Also illustrated schematically in FIG. **5** is a third flywheel magnet **126** mounted on the radially inward edge of the flange portion **128** of the flywheel **130**. As illustrated in FIG. **5** and in the cross sectional view of the flywheel illustrated in FIG. **6**, a two leg core assembly **132** of the type illustrated in FIG. **3** may be mounted in flux cutting proximity to the radially outer edge of the flywheel **130** so that rotation of the flywheel **130** induces a voltage in the charging coil C wound thereon twice during one complete rotation of the flywheel at 180° intervals.

A departure from the trigger coil assembly illustrated in FIG. **3** is required for the operation of a two cylinder engine circuit as described in connection with FIG. **4** in that two triggering coils T_1 and T_2 are required to generate the triggering signals at the proper sequence. With continued reference to FIGS. **5** and **6**, a pair of coil assemblies **134** and **136** may be mounted internally of the flange **138** of the flywheel **130**. These coil assemblies may be diametrically opposed and spaced equidistant from a charging coil assembly **132**. By virtue of the arrangement illustrated, the capacitor **80** of FIG. **4** may be charged by the rotation of the flywheel magnet **124** past the coil assembly **132** and the SCR associated with one cylinder thereafter fired by the passage of the magnet **126** in flux cutting proximity to the trigger coil **136**. Continued rotation of the flywheel in a clockwise direction will bring the flywheel magnet **121** in flux cutting proximity to the coil assembly **132** to again charge the capacitor **80** and will bring the magnet **126** in flux cutting proximity to the trigger coil assembly **134** to fire the SCR associated with the second cylinder.

The location of the flywheel magnets **121** and **124** on the outer radius of the flywheel and the location of the magnet **126** on the inner radius of the flange **128**

achieves the desired isolation between the respective components. The polarity of the magnets and the orientation of the core assemblies may also be different to further the electromagnetic isolation such that the trigger magnet **126** will have no effect on the coil assembly **132** and the charging magnets **121** and **124** will have no effect on the trigger coil assemblies **134** and **136.**

The operation of the circuit may be as earlier described with the resistors **100** and **120** limiting the current passing through the diodes **98** and **118** respectively upon the breakdown thereof.

ADVANTAGES AND SCOPE OF THE INVENTION

As is readily apparent from the foregoing, the ignition system of the present invention achieves a substantial reduction in both volume and weight while simultaneously significantly improving the reliability over known systems. By means of an impedance such as a small resistor or diode connected in series between the cathode of the SCR and the primary winding of the ignition transformer, the cathode potential of the SCR may be raised such that the achievement of the SCR gate to cathode conduction bias is insufficient to maintain SCR conduction. This ensures turn off of the SCR between the desired ignition pulses. In addition, the use of a time or voltage responsive means to shunt the triggering potential away from the gate of the SCR immediately following the turn on of the SCR prevents the inadvertent conduction of the SCR upon the initial build up of the gate-cathode potential as a result of the charging of the ignition capacitor.

The use of an impedance means to reduce the amplitude of the minor peaks of the current induced in the trigger coil to a value below the triggering potential of the SCR renders the operation of the circuit of the present invention nonresponsive to the speed of magneto rotation.

The physical configuration of the components and the independent mounting of the ignition transformer on a ferrite core affords a compactness heretofore unknown. The transformer may be potted with the ignition circuit if desired. Moreover, the shut-off circuit of the present invention is a low voltage, low current circuit which is fire proof and which can be physically touched on the lead to the shut-off switch at any engine speed.

The circuit of the present invention may be utilized in connection with multiple cylinder engines either by means of a conventional distributor system or by means of a common charging coil and ignition capacitor with a separate trigger circuit for each cylinder. Timing for the operation of a multiple cylinder circuit may be achieved by the appropriate placement of flywheel magnets with isolation such as provided by the location of the charging and trigger current inducing magnets on opposite sides of the flywheel.

The present invention may be embodied in other specific forms without departing from the spirit or essential characteristics thereof. The presently disclosed embodiments are therefore to be considered in all respects as illustrative and not restrictive, the scope of the invention being indicated by the appended claims rather than by the foregoing description, and all changes which come within the meaning and range of equivalency of the claims are therefore intended to be embraced therein.

What is claimed:

1. An ignition circuit for an internal combustion engine comprising:
- a capacitor;
- means for periodically applying a unidirectional current to said capacitor responsively to engine rotation;
- a discharge circuit for said capacitor, said discharge circuit including the primary winding of an ignition transformer and an SCR connected in series;
- a trigger circuit means for periodically applying a triggering potential to the gate of said SCR responsively to engine rotation; and,
- selectively operable means for periodically applying a triggering potential to the gate of said SCR during the application of said unidirectional current to said capacitor.

2. The circuit of claim **1** wherein said trigger circuit means includes voltage responsive means for interrupting the application of triggering potential to the gate of said SCR.

3. The circuit of claim **1** including at least one additional discharge circuit with the primary winding of an ignition transformer and an SCR connected in series; and,
- a triggering circuit for each of said additional trigger circuits for periodically applying a triggering potential to the gate of the associated SCR responsively to engine rotation.

4. An ignition circuit for an internal combustion engine comprising:
- a capacitor;
- means for periodically applying a unidirectional current to said capacitor responsively to engine rotation in the forward direction;
- a discharge circuit for said capacitor, said discharge circuit including the primary winding of an ignition transformer in series with electronic switch means;
- a trigger circuit for periodically applying a triggering potential to said switch means responsively to engine rotation in the forward direction; and,
- means for interrupting the application of triggering potential to said switch means responsive to said trigger circuit means.

5. The circuit of claim **4** wherein said triggering potential interrupting means is responsive to the potential of the gate of said switch means.

6. The circuit of claim **4** wherein said electronic switch is an SCR; and,
- wherein said triggering potential interrupting means includes coil means and switching means for effectively shunting the current induced in said coil means away from the gate of said SCR.

7. The circuit of claim **6** including selectively operable means for periodically applying a triggering potential to the gate of said SCR in substantial synchronism with the application of said unidirectional current to said capacitor.

8. The circuit of claim **6** including impedance means connected in series with said coil means for limiting the triggering potential to a value nondestructive of said SCR at maximum engine speeds.

9. The circuit of claim **4** including selectively operable means for periodically applying a triggering potential to said switch means in substantial synchronism with the application of said unidirectional current to said capacitor.

10. The circuit of claim 4 including at least one additional discharge circuit for said capacitor, each of said additional discharge circuits including the primary winding of an ignition transformer in series with electronic switch means;

a trigger circuit for each of said additional discharge circuits for periodically applying a triggering potential to the associated switch means responsive to engine rotation; and,

means associated with each of said additional discharge circuit for interrupting the application of triggering potential to said switch means.

11. An ignition circuit for an internal combustion engine comprising:

a magnetic core having two legs adapted to be mounted adjacent to a rotating magnetic member of an engine with said legs displaced in the direction of rotation of said magnetic member;

a triggering coil wound about one leg of said magnetic core;

a charging coil wound about the other leg of said magnetic core;

a selectively operable shut-off coil wound about said other leg of said magnetic core;

an ignition transformer; and,

circuit means mounted between the legs of said magnetic core for applying a signal to the primary winding of said ignition transformer.

12. The circuit of claim 11 wherein said circuit means includes an ignition capacitor and an SCR and a diode connected in series across said ignition capacitor.

13. The circuit of claim 11 wherein said circuit means includes an SCR and voltage responsive means connected across said triggering coil to interrupt the application of a triggering potential to the gate of said SCR.

14. The circuit of claim 11 wherein said transformer and said magnetic core are potted to form a unitary structure.

15. The circuit of claim 14 wherein said transformer includes a ferrite core.

16. An ignition circuit for an internal combustion engine comprising:

a magnetic core having two legs adapted to be mounted adjacent a rotating magnetic member of the engine with said legs displaced in the direction of rotation of said magnetic member;

a triggering coil wound about one leg of said magnetic core;

a charging coil wound about the other leg of said magnetic core;

an ignition transformer having a ferrite core; and

circuit means including an ignition capacitor and an SCR connected in series across said ignition capacitor, said circuit means being mounted between the legs of said magnetic core for applying a signal to the primary winding of said ignition transformer and said circuit means including voltage responsive means connected across said triggering coil to interrupt the application of a triggering potential to the gate of said SCR.

17. In an ignition system wherein a capacitor charging current is generated by the movement of magnetic means through flux cutting proximity to a charging coil in response to the forward rotation of an engine and wherein an electronic switch triggering current is thereafter generated by continued movement of the magnetic means through flux cutting proximity to a trigger coil in response to the forward rotation of the engine to thereby effect discharge of the capacitor through the electronic switch and a high voltage transformer to the ignition device, the method of ensuring engine cutoff by the generation of a second triggering current for the electronic switch in substantial synchronism with the generation of the capacitor charging current whereby a discharge path for the capacitor is provided substantially coextensive with the generation of the capacitor charging current, the second triggering current being generated by the movement of the magnetic means through flux cutting proximity to a second trigger coil in response to the forward rotation of the engine.

18. In an ignition system wherein a capacitor charging current is generated by the movement of magnetic means through flux cutting proximity to a charging coil in response to the forward rotation of an engine and wherein an SCR triggering current is thereafter generated by continued movement of the magnetic means through flux cutting proximity to a trigger coil in response to the forward rotation of the engine to thereby effect discharge of the capacitor through the electronic switch and a high voltage transformer to the ignition device, the method of ensuring SCR cutoff by the interruption of the application of the triggering potential to the gate of the SCR responsively to the potential of the gate of the SCR.

19. A method comprising the steps of:

a. moving a first permanent magnet responsively to the forward rotation of an internal combustion engine in flux cutting proximity to a charging coil to thereby charge an ignition capacitor;

b. moving a second permanent magnet responsively to the forward rotation of an internal combustion engine in flux cutting proximity to a first trigger coil to thereby effect the discharge of the capacitor through a first ignition device;

c. moving a third permanent magnet responsively to the forward rotation of an internal combustion engine in flux cutting proximity to the charging coil to thereby charge the ignition capacitor;

d. moving a fourth permanent magnet responsively to the forward rotation of an internal combustion engine in flux cutting proximity to a second trigger coil to thereby effect the discharge of the ignition capacitor through a second ignition device;

e. moving the first and third permanent magnets responsively to the forward rotation of an internal combustion engine in flux cutting proximity to a shut-off coil coaxial with the charging coil; and,

f. selectively utilizing the output signal from the shut-off coil to prevent the charging of the ignition capacitor to ignition potential.

20. An ignition circuit for an internal combustion engine comprising:

an ignition capacitor;

an SCR;

an ignition transformer;

a magnetic core having two legs adapted to be mounted adjacent to a rotating magnetic member of an engine with said legs displaced in the direction of rotation of said magnetic member;

a triggering coil wound about one leg of said magnetic core, said triggering coil being connected to the gate of said SCR;

a charging coil wound about the other leg of said magnetic core, said charging coil being connected to said ignition capacitor by a circuit excluding mechanical switch contacts;

a shut-off coil wound about said other leg of said magnetic core, said shut-off coil being connected to the gate of said SCR through mechanical contacts; and,

circuit means connecting said ignition capacitor in series with said SCR and the primary winding of said ignition transformer.

21. In an ignition system for an internal combustion engine wherein a capacitor charging current is generated by the movement of magnetic means through flux cutting proximity to a charging coil in response to the forward rotation of an engine, and wherein an electronic switch triggering current is generated by movement of the magnetic means through flux cutting proximity to a trigger coil in response to the forward rotation of the engine to thereby effect discharge of a capacitor through an electronic switch and a high voltage transformer to an ignition device, the improvement in decreasing the effects of conducting debris comprising the provision of a shut-off coil and mechanical switch contacts in the trigger circuit for the electronic switch in lieu of mechanical switch contacts in the charging coil circuit, said trigger coil ensuring engine cutoff by the generation of a triggering current in substantial synchronism with the generation of the capacitor charging current.

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