United States Patent

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[54] GAS IGNITER SYSTEM
14 Claims, 4 Drawing Figs.

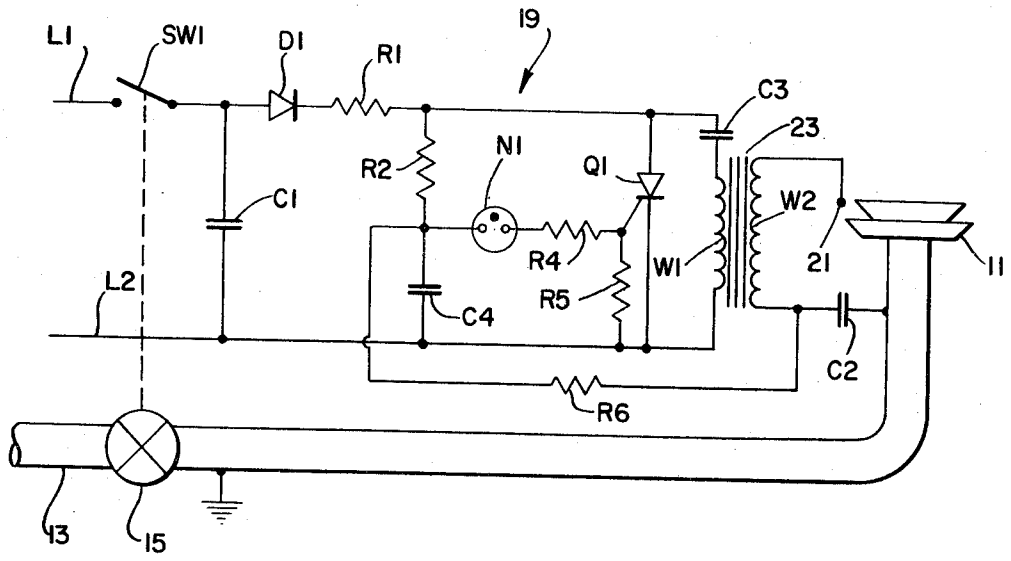
[52] U.S. Cl. 431/264, 317/96
[51] Int. Cl. F23q 3/00
[50] Field of Search 431/264, 266; 317/74, 96, 93, 97

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ABSTRACT: The AC powered, electronic igniter system disclosed herein generates sparks to ignite gas at a burner and includes means for inhibiting sparking when a flame is present at the burner. The spark gap itself is resistively isolated from the AC supply to prevent the creation of a shock hazard without requiring an AC power transformer.



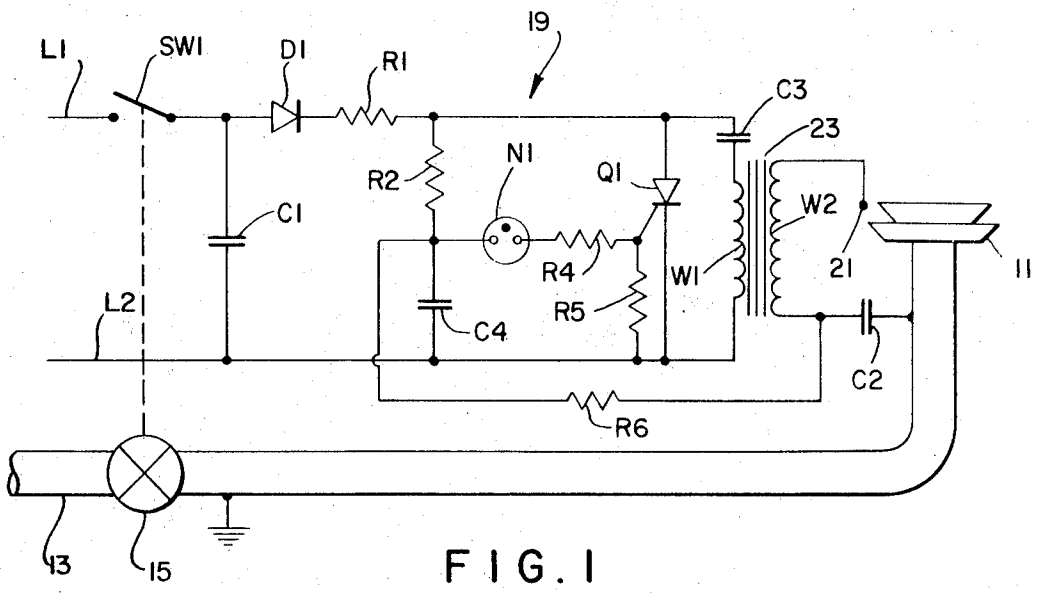


FIG. 1

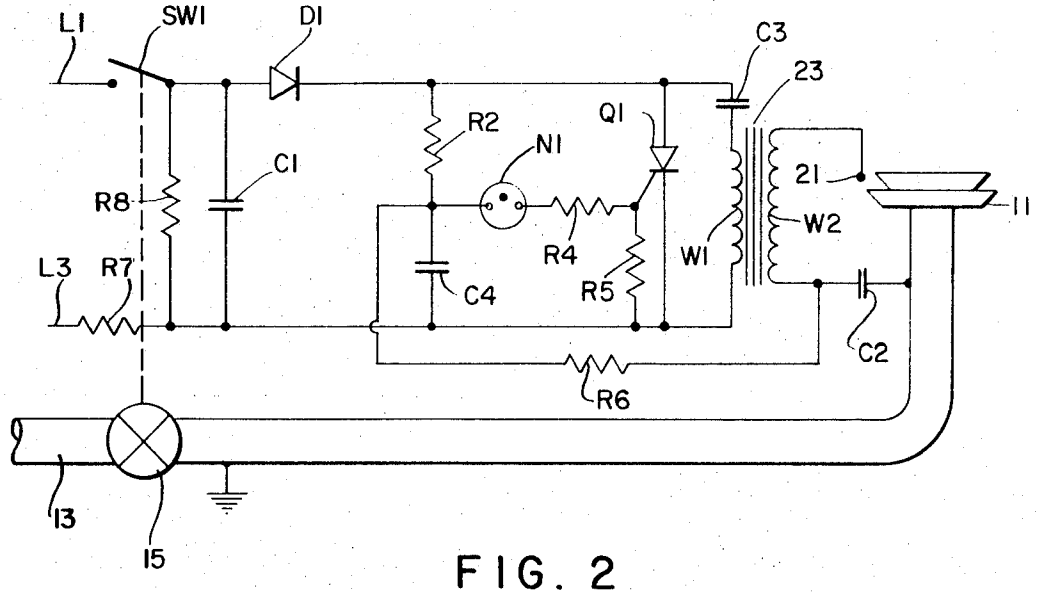


FIG. 2

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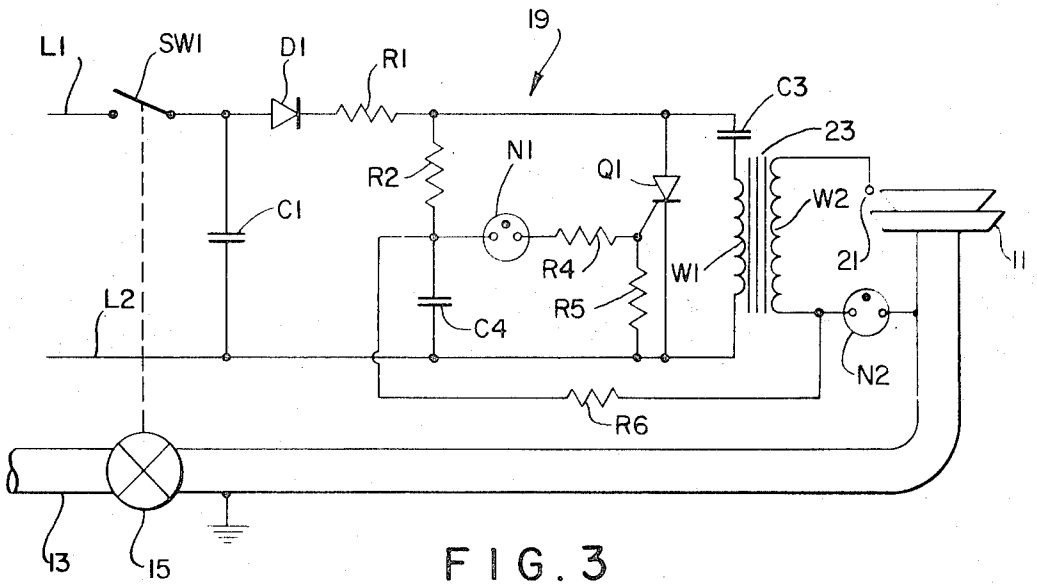


FIG. 3

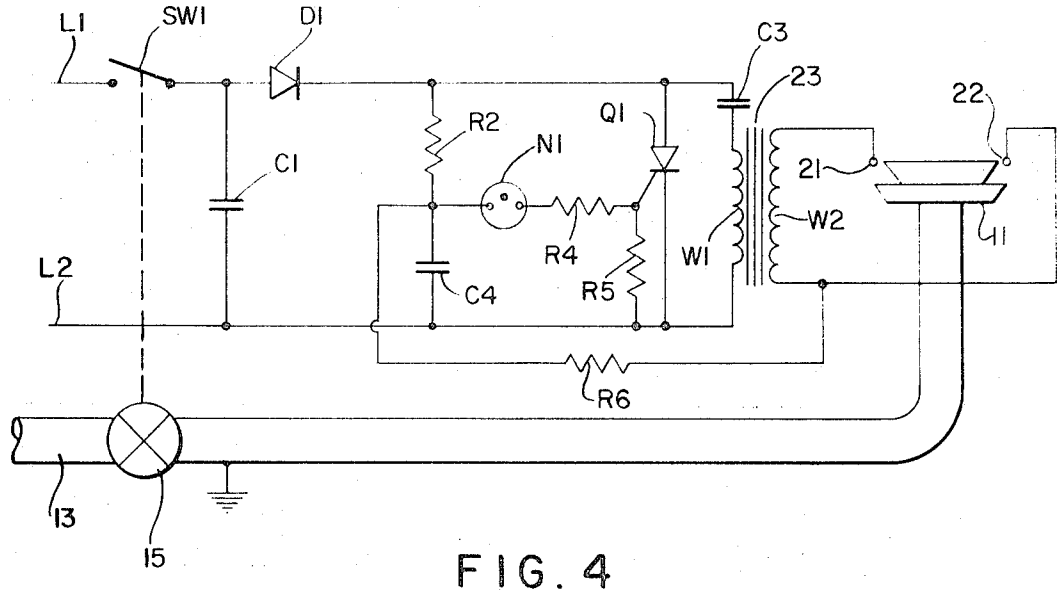


FIG. 4

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GAS IGNITER SYSTEM

This is a continuation in part of application, Ser. No. 793,832, filed Jan. 24, 1969.

BACKGROUND OF THE INVENTION

This invention relates to an AC powered, electronic gas igniter system and more particularly to such a system in which the spark gap is isolated from the AC supply.

Various electronic gas igniter systems have been devised heretofore which would generate sparks for igniting gas at a burner and which would inhibit sparking in response to the presence of a flame at the burner. However, such systems typically require the use of a relatively expensive AC power transformer to isolate the spark gap itself from the power source and to thereby prevent the creation of a shock hazard. Such prior systems are illustrated, for example, in U.S. Pat. No. 3,377,125 issued to R. J. Zielinsky on Apr. 9, 1968.

Among the several objects of the present invention may be noted the provision of an AC powered igniter system in which the spark gap is isolated from the AC supply; the provision of such a system which does not employ an AC power transformer; the provision of such a system which is highly reliable; the provision of such a system which is relatively insensitive to transient pulses; the provision of such a system which may be operated from different supply voltages; and the provision of such a system which is relatively simple and inexpensive. Other objects and features will be in part apparent and in part pointed out hereinafter.

SUMMARY OF THE INVENTION

Briefly, a transformerless igniter system according to the present invention is adapted to be energized from a pair of AC supply leads and to ignite gas at a burner. A spark gap is defined adjacent the burner by means which includes at least one electrode. A spark coil is provided having a primary winding and a secondary winding. One side of the secondary winding is connected to the electrode and the other side of the secondary winding is connected, by means including a coupling capacitor, to the side of the spark gap which is opposite the electrode. A first circuit means, including a relatively high value timing resistance, applies a charging current to the timing capacitor from the AC supply leads and a second circuit means, including a relatively high value isolating resistance, connects the aforesaid other side of the secondary winding to the timing capacitor. A triggerable semiconductor current switching device is connected to apply an electric pulse to the primary winding of the spark coil and the device is triggered when the voltage on the timing capacitor exceeds a predetermined level, thereby to generate a spark at the gap. A flame at the burner shunts the timing capacitor through the isolating resistance and prevents the voltage on the timing capacitor from reaching the predetermined level, thereby inhibiting sparking. The isolating resistance isolates the spark gap itself from the AC supply leads.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic circuit diagram of a transformerless gas igniter system of the present invention;

FIG. 2 is a schematic circuit diagram of a modification adapted for use with a relatively high AC supply voltage.

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

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, a conventional gas burner is indicated at 11. Gas is provided to burner 11 from a supply main 13 through a valve 15. The burner 11 is assumed to be electrically grounded as indicated. Valve 15 is mechanically coupled to and controls the operation of a switch SW1, the switch being closed when the valve is opened. Switch SW1 controls the energization of the electronic igniter system of this invention, indicated generally at 19, from a pair of AC supply leads

L1 and L2. Leads L1 and L2 are connected to an appropriate AC power source such as conventional 120-volt 60-cycle AC supply mains, the lead L2 preferably being the neutral or ground connection. High-frequency transients are shunted by a capacitor C1 to prevent damage to or false triggering of the semiconductor components employed in the igniter system.

An electrode, designated 21, is physically mounted next to burner 11 so as to define therewith a spark gap which is adjacent the gas outlet portion of the burner. A spark coil 23 is provided for producing sparks across the gap. Spark coil 23 comprises a relatively low voltage primary winding W1 and a high-voltage secondary winding W2. One side of secondary winding W2 is connected directly to the electrode 21 while the other side is connected, through a pulse-coupling capacitor C2, to the burner 11 which constitutes the side of the spark gap opposite the electrode 21.

One end of primary winding W1 is connected to the lead L2 and the other end is connected, through an energy storage capacitor C3, to the anode of an SCR (silicon-controlled rectifier) Q1. The cathode of SCR Q1 is connected to the ground lead L2 and the gate-cathode circuit is shunted by a resistor R5 for bypassing leakage currents.

Capacitor C3 is selectively charged from the AC supply leads L1 and L2 through a circuit which includes a rectifying diode D1 and a resistor R1. Unidirectional current, obtained through diode D1 and resistor R1, is also applied, through a timing resistor R2, to charge a timing capacitor C4. This ungrounded side of capacitor C4 is also connected, through a neon lamp N1 and a current limiting resistor R4, to the gate of the SCR Q1. As is understood by those skilled in the art, a neon lamp such as that indicated at N1 is a voltage breakdown device which will conduct only after the voltage applied thereto exceeds a predetermined threshold and will cease conducting only when the applied voltage drops to a substantially lower level. When lamp N1 breaks into conduction, a triggering pulse is applied to the gate of SCR Q1.

The operation of this system is substantially as follows.

When the valve 15 is opened to admit gas to burner 11, the electronic igniter system 19 is energized from the AC supply leads L1 and L2 through switch SW1 and capacitor C3 charges through resistor R1. At the same time, capacitor C4 charges through resistor R2. However, since resistor R2 is energized only from the voltage on capacitor C3, capacitor C4 charges more slowly than capacitor C3. When the voltage on capacitor C4 reaches the breakdown threshold of lamp N1, SCR Q1 is triggered. Conduction through SCR Q1 applied a sharp current pulse to the primary winding W1, the energy previously stored on capacitor C3 being discharged into the spark coil 23 to generate a spark across the gap between electrode 21 and burner 11. After the spark is generated, SCR Q1 is turned off by reducing of the spark coil 23.

The charging of the capacitors C3 and C4 and the firing of SCR Q1 will repeat periodically as long as the spark gap exhibits a relatively high impedance. However, once the gas is ignited and a flame is present at the burner, the resulting ionized gases in the spark gap will lower its effective DC impedance. This lowered gap impedance, acting through the resistor R6, shunts the timing capacitor C4 and prevents it from being charged to the voltage necessary to fire the neon lamp N1. Accordingly, sparking at the gap will be inhibited whenever a flame is present at the burner. If the flame at the burner should be extinguished, other than by closing valve 15, the igniter circuit 19 will automatically resume sparking so that, if gas is still flowing to the burner, it will be reignited.

As the extremely high impedance of the neon lamp N1 prior to breakdown allows a relatively high value resistor to be employed as the charging resistor R2, it can be seen that the resistor R6 can likewise be of relatively high value without interfering with the automatic-spark-inhibiting operation. The relatively high value of resistor R6 quite effectively isolates the secondary winding W2 and the spark gap from the AC source for safety purposes. In other words the current which could be drawn from the source through resistor R6 is much less than

that which would represent a danger to human life. Thus, even if the supply leads in the FIG. 1 embodiment were misconnected, e.g. by inserting the usual AC supply cord plug in a reversed manner, so that the lead L1 was grounded instead of lead L2, no significant current could be drawn from the AC source through the electrode. In contrast, if the secondary winding W2 were connected directly to capacitor C4 without the isolating resistance R6 and lead L2 were inadvertently connected to the ungrounded side of the AC supply, capacitor C4 could transmit a dangerous amount of AC from lead L2 to the electrode.

The use of resistive isolation eliminates the need for an AC power transformer to isolate the entire igniter system from the AC supply leads. Thus, this system is transformerless in the sense that no AC power transformer is employed. Accordingly, as used herein and in the claims, the term transformerless should be understood to mean a system which does not include an AC power isolating transformer although it may include a pulse transformer or transformer type spark coil such as indicated at 23 in the drawings.

The embodiment illustrated in FIG. 2 is energized through a pair of supply leads L1 and L3 which are provided with AC voltages which are of opposite polarity with respect to ground, e.g., by being connected to conventional 240-volt 60-cycle AC supply mains. An intermediate voltage which is substantially equal to ground potential is provided by means of a pair of dropping resistors R7 and R8 which are connected in series across the leads L1 and L3. As the resistor R7 provides current limiting or delay in charging capacitor C3, the resistor R1 of FIG. 1 is omitted. However, the remainder of the circuit is essentially the same and functions in substantially identical manner, the higher source voltage being reduced to level comparable to that used in FIG. 1 by the resistors R7 and R8.

In the embodiments of FIGS. 1 and 2, the capacitor C2 is employed to pass the igniting pulses while presenting an essentially open circuit to the DC charging current flowing to the timing capacitor C4. In other words, capacitor C2 functions as a discriminator means. In the embodiment of FIG. 3, this discrimination function is provided by the neon tube or other gas discharge tube N2 which functions as a voltage breakdown device and is selected to have a higher breakdown potential than the tube N1. During charging of the timing capacitor C4, the tube N2 acts essentially as an open circuit since the voltage across capacitor C4 does not reach the ignition threshold of tube N2. However, when the SCR Q1 is triggered, the resulting high-voltage pulse developed across the transformer secondary winding causes tube N2 to conduct and to produce a sparking potential between the electrode 21 and the burner.

In the embodiment of FIG. 4, this function of conducting the sparking pulse and acting as an open circuit to the current-charging capacitor C4 is provided by a second spark gap. This second gap is formed between the burner and a second electrode 22. Electrode 22 is connected to the end of secondary winding W2 opposite to electrode 21. Assuming no flame is present, this second gap acts as an open circuit and permits capacitor C4 to charge through resistor R2. However, when SCR Q1 if fired, both spark gaps break down and produce sparking for igniting the fuel. After a flame is established, both gaps act to shunt the charging current through the ions present in the flame. As in the previous embodiments, the resistor R6 provides isolation preventing harmful shocks from the electrodes 21 and 22.

In view of the foregoing, it may be seen that several objects of the present invention are achieved and other advantageous results have been attained.

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

What is claimed is:

1. A transformerless igniter system adapted to be energized from a pair of AC supply leads and to ignite gas at a burner, said system comprising:

means, including at least one electrode, for defining a spark gap adjacent said burner;

a spark coil having a primary winding and a secondary winding;

means for connecting one side of said secondary winding to said one electrode;

means, including a coupling capacitor, for connecting the other side of said secondary winding to the side of said spark gap which is opposite said one electrode;

a timing capacitor;

first circuit means, including a relatively high value timing resistance, for applying a charging current to said timing capacitor from said AC supply leads;

second circuit means, including a relatively high value isolating resistance, for connecting said other side of said secondary winding to said timing capacitor;

a triggerable semiconductor current-switching device connected to apply an electric pulse to said primary winding; and

means for triggering said switching device when the voltage on said timing capacitor exceeds a predetermined level to generate a spark at said gap, whereby a flame at said burner shunts said timing capacitor through said isolating resistance and prevents the voltage on said timing capacitor from reaching said predetermined level thereby inhibiting sparking and whereby said isolating resistance isolates said spark gap means from the AC supply leads.

2. An igniter system as set forth in claim 1 wherein said burner defines the side of said spark gap opposite said electrode.

3. An igniter system as set forth in claim 1 wherein said triggerable switching device comprises an SCR.

4. An igniter system as set forth in claim 3 including an energy storage capacitor which is discharged by said SCR into the primary winding of said spark coil to generate a spark at said gap.

5. An igniter system as set forth in claim 4 wherein said first circuit means which applied a charging current to said timing capacitor is connected to said energy storage capacitor whereby said timing capacitor charges more slowly than said energy storage capacitor.

6. An igniter system as set forth in claim 1 including a voltage divider comprising a pair of resistors for obtaining an intermediate voltage from AC voltages of opposite polarity applied to said supply leads.

7. An igniter system as set forth in claim 6 wherein said intermediate voltage is substantially equal to ground potential.

8. An igniter system as set forth in claim 1 wherein said means for triggering said switching device comprises a neon lamp.

9. A transformerless igniter system adapted to be energized from a pair of AC supply leads and to ignite gas at at burner, said system comprising:

an electrode, adapted to be mounted adjacent said burner for defining a spark gap therewith;

a spark coil having a primary winding and a secondary winding, one side of said secondary winding being connected to said electrode;

a coupling capacitor for connecting the other side of said secondary winding to said burner;

an energy storage capacitor;

means, including a rectifier, for charging said energy storage capacitor from said supply leads;

a timing capacitor;

first circuit means, including a relatively high value timing resistance, for applying a charging current to said timing capacitor from said storage capacitor;

second circuit means, including a relatively high value isolating resistance, for connecting said other side of said secondary winding to said timing capacitor;

an SCR connected to discharge said energy storage capacitor through said primary winding; and

a neon lamp connected between said timing capacitor and the gate of said SCR for triggering said SCR when the

voltage on said timing capacitor exceeds a predetermined level thereby to generate a spark at said gap, whereby a flame at said burner shunts said timing capacitor through said isolating resistance and prevents the voltage on said timing capacitor from reaching said predetermined level thereby inhibiting sparking and whereby said isolating resistance isolates said electrode from the AC supply leads.

10. A transformerless igniter system adapted to be energized from a pair of AC supply leads and to ignite gas at a burner, said system comprising:

means, including at least one electrode, for defining a spark gap adjacent said burner;

a spark coil having a primary winding and a secondary winding;

means for connecting one side of said secondary winding to said one electrode;

a timing capacitor;

first circuit means, including a relatively high value timing resistance, for applying a charging current to said timing capacitor from said AC supply leads;

second circuit means, including a relatively high value isolating resistance, for connecting said other side of said secondary winding to said timing capacitor;

a triggerable semiconductor current-switching device connected to apply an electric pulse to said primary winding;

means for triggering said switching device when the voltage on said timing capacitor exceeds a predetermined level thereby to generate a sparking pulse; and discriminating means presenting an essentially open circuit to said charging current and being conductive of said sparking pulse for connecting the other side of said secondary winding to the side of said spark gap which is opposite said one electrode, whereby a flame at said burner shunts said timing capacitor through said isolating resistance and prevents the voltage on said timing capacitor from reaching said predetermined level thereby inhibiting sparking and whereby said isolating resistance isolates said spark gap means from the AC supply leads.

11. An igniter system as set forth in claim **10** wherein said discriminating means is a capacitor.

12. An igniter system as set forth in claim **10** wherein said discriminating means is a voltage breakdown device.

13. An igniter system as set forth in claim **12** wherein said breakdown device is a neon tube.

14. An igniter system as set forth in claim **12** wherein said breakdown device is a second spark gap.

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