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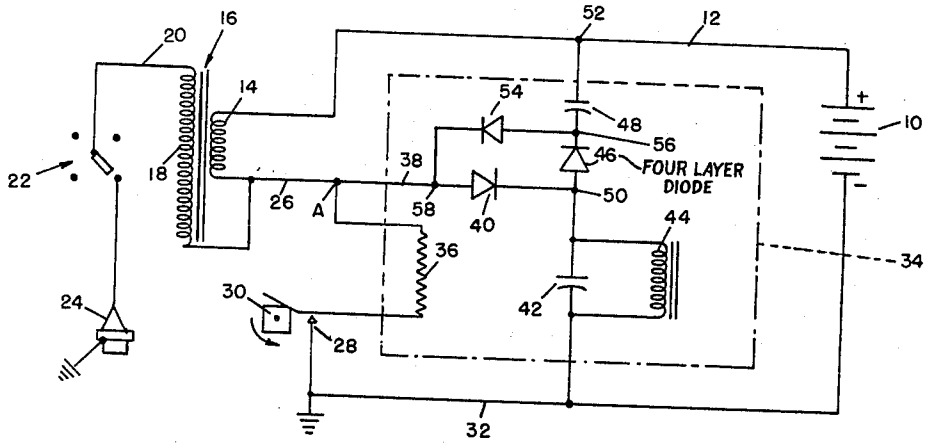
[54] **IGNITION OR LIKE SYSTEM**
7 Claims, 1 Drawing Fig.

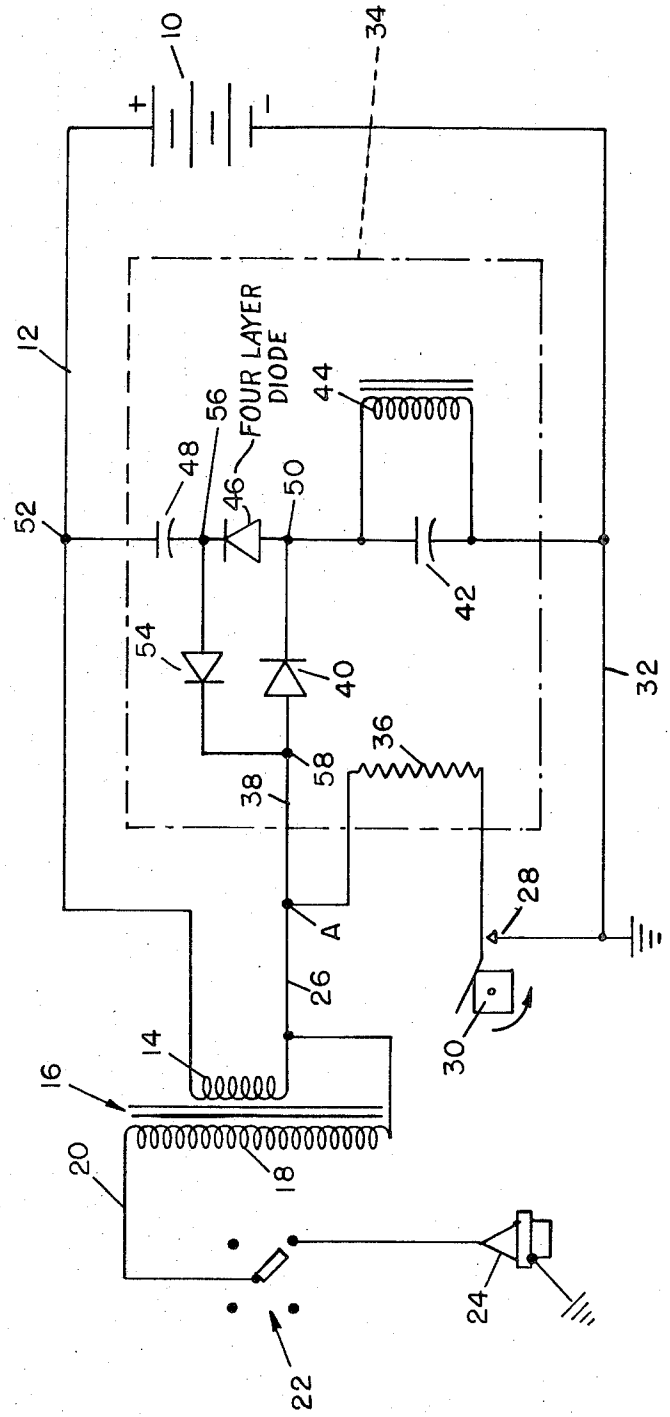
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[56] **References Cited**
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ABSTRACT: A rapidly interrupted induction system such as the ignition system for internal combustion engines in which substantially nonarcing interruption and more efficient spark plug operation is accomplished by solid state circuitry including a storage capacitor of large capacity which is connected across the interrupter and a smaller capacitor which is fed from the storage capacitor and provides high frequency oscillations through the primary of an induction transformer.





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IGNITION OR LIKE SYSTEM

This invention relates to rapidly interrupted induction systems, and more particularly to ignition systems for internal combustion engines or the like.

Ignition systems or the like, a number of which include solid state components, are well known in the prior art. The system of the invention, however, provides less arc-over burning of the interrupter contact points and more efficient operation of the sparking apparatus.

An object of the present invention, therefore, is to provide a novel and inexpensive interrupted inductive system in which the arc-over tendency of the interrupter is substantially alleviated, thereby to increase the burn-out life of the contact points of the interrupter.

A further object is to maintain the conductance characteristics of the interrupter contacts such that substantially no variation in output occurs during repeated breaking of the contacts.

A further object is the provision of an ignition system in which the charging of a storage capacitor provides better preignition firing conditions.

A further object is to provide an ignition or like system in which a storage capacitor feeds energy into a smaller capacitor which in turn provides high frequency oscillations through the primary of an inductance transformer.

In the illustrated embodiment of the invention, the conventional battery, spark coil or induction transformer, interrupter points, distributor and spark plugs are utilized. The present invention differs from the conventional system in one aspect, however, in that a low ohmage resistor is connected in the interrupter circuit and a diode controlled large storage capacitor shunted by an inductance of relatively high DC resistance is connected across the interrupter A second circuit controlled by solid state elements includes a smaller capacitor which is fed by the storage capacitor and provides high frequency oscillations through the primary of the aforesaid spark coil or induction transformer.

The above and other objects, advantages and features of the invention will be apparent from the following description taken in conjunction with the accompanying drawing.

In the drawing, the FIG. is a schematic wiring diagram illustrating an exemplary embodiment of the invention.

Referring to the drawing, a battery **10** which may be the usual 6- or 12-volt battery of an automotive vehicle or the like is connected by line **12** to the primary **14** of a spark coil or induction transformer **16**. The secondary **18** of the transformer **16** is connected by line **20** to the usual distributor **22** and spark plugs **24**. A line **26** connects the other side of primary **14** with the breaker contacts or points **28** of an interrupter **30** and thence by line **32** to the battery **10**. The circuitry thus far described is conventional in ignition systems for internal combustion engines except that the capacitor normally connected across the breaker contacts is eliminated. The improvements of the present invention reside within the broken lines designated by the reference numeral **34**.

Referring to this new portion of the system, a low ohmage resistor **36** (in the order of 0.25 ohms in a 6-volt battery system for example) is connected in the lead connection **26** to the breaker contacts **28**. A circuit including a line **38**, a diode **40**, a storage capacitor **42** of large capacity (in the order of 0.5 ufd for example) shunted by an inductance **44** (having an inductance of 4mh and a DC resistance of 200 ohms, for example) is connected across the resistor **36** and the interrupter contacts **28** so as to be in parallel therewith. A second circuit comprising a four-layer diode **46** and a capacitor **48** of relatively small capacitance (in the order of 0.05 ufd for example) is connected between the input point **50** of the C-L circuit **42–44** and point **52** on line **12**. This second circuit also includes a diode **54** connecting the junction **56** between diode **46** and capacitor **48** with a junction **58** on the line **38** at the anode side of diode **40**. As shown in the drawing, the diodes **40** and **46** are polarized to conduct toward the storage capacitor **42** and the small capacitor **48**, respectively, while the diode **54** is polarized to conduct away from the capacitor **48** and toward the primary **14**.

The operation is as follows. Referring to FIG. **1**, the cycle begins on open contact with current flow stabilized through the primary **14** of transformer **16**, the diode **40**, and the inductance **44**. Under these conditions the relatively high DC resistance of the inductance **44** (200 ohms for example) and the low resistance of the primary **14** (1ohm for example) keep the voltage at point A and across capacitor **42** at nearly the supply voltage of the battery. This condition is stable and can be continued indefinitely.

When the contacts **28** close, a new circuit is established through the primary **14** and the resistance **36**. Voltage at point A drops suddenly to near zero. At this time capacitor **42** does not discharge through the closed contacts, but through the inductance **44** because of the isolating or blocking effect of diode **40**. The rate of discharge is determined entirely by the LC parameters of **44** and **42**. When the voltage across capacitor **42** drops below that at point A, conditions suddenly change due to the effective low-resistance short circuit comprising the breaker contacts **28**, resistance **36**, and diode **40**, and a long time-constant effect is created which keeps the voltage negative across capacitor **42** and inductance **44** until the contacts open, causing the magnetic field in the primary to collapse.

Normally the opening of the contacts would result in a rapid, high rise of voltage at point A and a tendency for an arc to establish itself across the opening gap. This occurs because at the time of opening, when the voltage at point A is rising, the current of self-induction will seek to retain a closed path and will attempt to bridge the opening gap. In a conventional circuit without diode **40** and resistance **36**, energy would be dissipated as destructive arcing which would reduce the output at the secondary. In the circuit of this invention, two possible paths are provided which are distinguished by an exaggerated difference of impedance. The path through the opening contacts has an added resistance **36** interposed, whereas the path through diode **40** leads to the low impedance of a large capacitor (storage capacitor **42**) which is negatively charged. Because of the relatively large size of capacitor **42** (0.5 ufd for example) the rate of rise, as well as the maximum of the voltage produced by the self-inductance of the primary, is reduced.

Should the contact conditions favor arc production because of transient irregularities on the contact surface, the first surge of current across the opening gap would drop the voltage at point A, break the circuit to the capacitor through diode **40** and prevent its feeding the arc. Simultaneously a countersurge is produced by capacitor **42** and inductance **44** to inhibit the forming arc. This action can repeat itself several times if necessary, but as the gap is widening continuously the tendency to arc is progressively diminished.

In a conventional circuit without diode **40** and resistance **36** the break at the contacts results in a period of arc formation wherein voltage rises until current flows across the gap, drops as a result, then rises again until current flows, then it drops again repeatedly until a point is reached when current can no longer reestablish itself across the widening gap. Each time that current bridges the gap, energy is supplied primarily from the normally shunted capacitor because of its low internal impedance. The energy dissipated in this series of aborted arcs is destructive to the contacts, and reduces the energy available for spark production. In the circuit of this invention any attempt at arc formation cannot draw energy from the capacitor because of the isolating diode **40**, and therefore the duration and intensity of each attempt is diminished.

In this way the major part of the energy of self-inductance appears as a charge on capacitor **42** which is transferred by steps to capacitor **48** through the four-layer diode **46** which has the characteristic of sudden changing to a conducting state when its trigger point (typically 30 volts) is reached. Current now reverses and a high frequency oscillatory condition through diode **54** and primary **14** utilizes the energy of capacitor **48** which is repeatedly replenished by capacitor **42**. The rapid alternations react on the secondary **18** to produce a high voltage suitable for ignition in an internal combustion engine.

This continues until there is insufficient energy to bridge the gap of the spark plug, or pressure in the combustion chamber rises to prevent further sparking.

During the period of initial charging of the large storage capacitor **42**, a spark does not occur at the spark plug because of the slow rate of rise of the current through the primary and consequent low voltage in the secondary. Nonetheless as EMF does appear across the spark plug gap, and distributes itself in accordance with the effective capacitances in the distributor and spark plug assembly to foster an ionization process in the vicinity of the spark plug which assists in the combustion sequence initiated by the spark.

An improved ignition or like system is thus provided in which the large current through the primary is carried by metallic contacts and the solid state devices pass only pulses whereby the problem of heat dissipation is minimal. The contacts retain their low resistance because of the arc-inhibiting circuit, consequently there is no heat buildup and therefore no deterioration in performance. The method of storing energy permits the metering of the output so that full-strength sparking occurs over a substantial ignition period. The presence of a voltage on the spark plug electrodes during the charging of the storage capacitor and prior to the passage of the igniting spark induces an ionization which facilitates the chemical process of combustion and the passage of the spark. The basic coil, breaker contacts, and distributor system as well as all engineering refinements developed over a period of years are retained. The system modifies only the electrical behavior to improve operation.

While the system of the invention has been specifically described in connection with a 6-volt DC source, by way of example, it is readily adapted to a 12-volt or like system by using a resistor **36** of higher resistance, in the order of 0.5 ohms for example. Battery polarity is similarly not critical, requiring only that the three diodes be reversed. It will be also be apparent that other modifications, changes and alterations may be made without departing from the spirit of the invention, and it is intended to be limited only by the scope of the appended claims.

I claim:

1. In a rapidly interrupted induction system such as the ignition system for internal combustion engines wherein the primary of an inductance transformer and the breaker contacts of an interrupter means are connected in series with a DC source of power, the improvement which includes a low ohmage series resistance connected in the circuit between said transformer primary and said interrupter contacts, a storage capacitor of relatively high capacity connected across the DC source, an inductance connected in shunt across said capacitor and diode circuit means for connecting said storage capacitor and said shunt connected inductance across said resistance and said interrupter contacts so as to be in parallel therewith, said diode circuit means being positioned electrically between said resistance and said capacitor and polarized so as to be conductive toward the capacitor.

2. An induction system as defined in claim **1** which further includes a second capacitor of relatively low capacitance connected in parallel with said primary between said storage capacitor and said DC source of power, a second diode means having a predetermined triggering voltage connected in the circuit between said storage capacitor and said second capacitor, and a third diode means having one side connected to a junction between said second diode means and said second capacitor and the other side connected to a junction between said first named diode means and said primary, said second diode means being polarized so as to be conductive toward said second capacitor and said third diode means being conductive toward said primary.

3. An induction system as defined in claim **1** in which the value of said resistance is in the order of 0.25 —0.50 ohms and said inductance has a DC resistance value in the order of 200 ohms.

4. An induction system as defined in claim **2** in which said second diode means comprises a four-layer diode.

5. An induction system as defined in claim **2** in which said storage capacitor has a capacitance in the order of 0.5 ufd and said second capacitor has a capacitance in the order of 0.05 ufd.

6. An inductive system as defined in claim **2** in which each of said diode means comprises a solid state device.

7. In an ignition or like system, the combination including a source of DC power; the primary of an inductance transformer and interrupter contact means connected in series across said source; a resistance connected in the circuit between said primary and said interrupter contact means; a first circuit means including a diode and a capacitance-inductance circuit connected in parallel with said resistance and interrupter contact means; and a second circuit means connected in parallel with said transformer primary; said second circuit means connected to said first circuit means by a second diode, said second circuit means including a second capacitor repeatedly charged by said first capacitor through said second diode and discharging through said primary.