United States Patent

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[54] CONDENSER DISCHARGE TYPE IGNITION SYSTEM WITH A MAGNETO POWER SUPPLY

10 Claims, 1 Drawing Fig.

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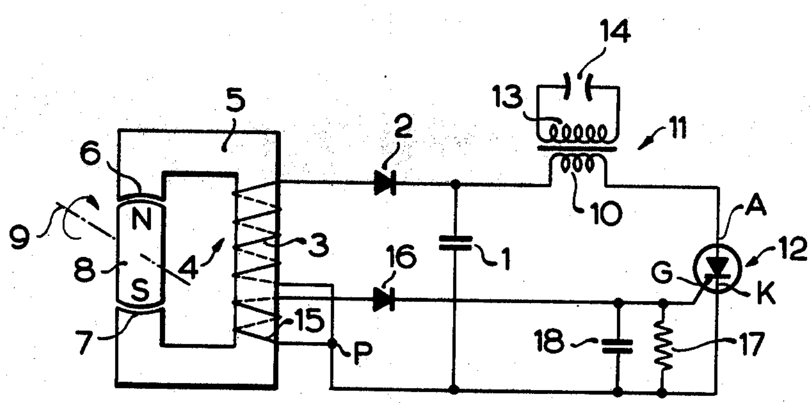
ABSTRACT: An ignition arrangement for firing spark plugs in internal combustion engine without the aid of a battery or electrical power supply. The energy required for firing the spark plugs is derived from the rotating crank shaft on the engine to which a permanent magnetic member is coupled. The magnetic member moves within the path of a ferromagnetic core upon which a charging winding and an auxiliary winding are wound. The motion of the permanent magnetic member varies the magnetic flux through the core and thereby induces voltages in the two windings wound upon the core. An ignition capacitor connected to the charging winding and the control electrode of a semiconductor control rectifier is connected to the auxiliary winding. The capacitor is charged from the voltage induced in the charging winding, and is discharged through the primary winding of an ignition transformer. The discharge of the capacitor is controlled by the semiconductor control rectifier, by the voltage applied to its control electrode. The spark plug to be fired is connected across the secondary winding of the ignition transformer, and the firing electrical impulse is induced in the secondary winding upon the discharge of the capacitor through the primary winding.



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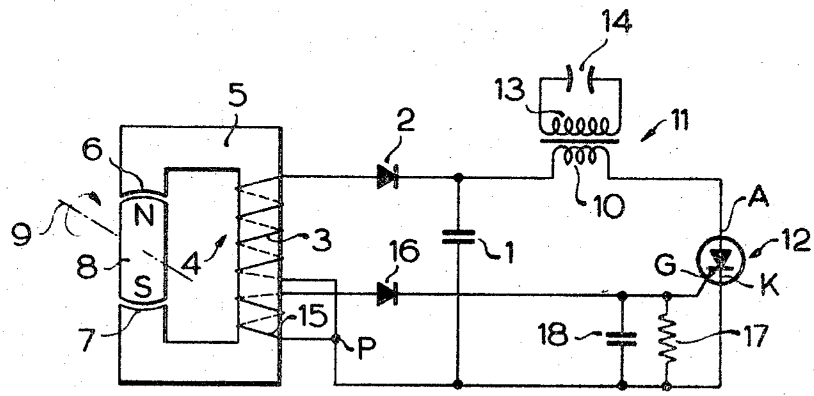

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CONDENSER DISCHARGE TYPE IGNITION SYSTEM WITH A MAGNETO POWER SUPPLY

BACKGROUND OF THE INVENTION

In the present invention the ignition energy is stored in an ignition capacitor which is charged through a charging coil acted upon by a magnetic system driven relative to the internal combustion engine. The ignition capacitor is discharged through an electronic switch and circuit path containing no switching contacts. The energy is discharged through the primary winding of an ignition transformer. The latter concludes a secondary winding which is connected to at least one spark plug.

The ignition arrangement in accordance with the present invention is particularly applicable where no battery is available to supply power. As a result of storing the ignition energy in the ignition capacitor, a high voltage impulse having a steep front edge is attained at the instant of ignition within the secondary winding of the ignition transformer. As a result, even spark plugs with severely soiled spark electrodes are fired with a spark across them, with much assurance. The application of mechanical switches for the purpose of controlling the ignition process, can thus be avoided. Such mechanical switches introduce unreliability in the operation of the ignition arrangement because they are easily damaged through sparking and oil deposits.

From the German Pat. 1,228,461 an ignition arrangement is known in which the control voltage for the control electrode of the electronic switch is taken from the charging coil wound in the same sense. The control voltage for the control electrode of the electronic switch, as well as the charging voltage for the ignition capacitor have thereby the same origin and the same phase relationship. In order to achieve an optimum ignition impulse, the ignition capacitor must be fully charged at the instant at which the discharge process is to be initiated. This is the case when the half sine wave can act upon the ignition capacitor in a charging manner until it attains its peak value. This requires that the circuit path of the electronic switch be switched to the conducting state when the peak value is precisely attained. This required condition, however, cannot be attained with assurance, because the voltage function or wave form within the region of the peak value is relatively flat. As a result a voltage value becomes sufficient for switching the electronic switch before the peak value is attained. Aside from this, the possibility exists that when the internal combustion engine is at a low speed, the required voltage is not at all attained for purposes of controlling the electronic switch. It is furthermore undesirable that the charging coil makes still available voltage to the ignition capacitor While it is being discharged.

Accordingly, it is the object of the present invention to provide an ignition arrangement designed so as to avoid the disadvantages of the common known arrangement. This object is achieved by providing an auxiliary winding upon the charging coil which contains also the charging winding for providing the charging voltage of the ignition capacitor. The auxiliary winding provides a control voltage for application to the control electrode of the electronic switch. This control voltage from the auxiliary winding is of opposite phase in relation to the voltage derived from the charging winding on the charing coil.

SUMMARY OF THE INVENTION

An ignition arrangement for internal combustion engines requiring no battery or external power supply. A permanent magnet is moved relative to the ferromagnetic core upon which a charging winding is wound. As a result of the motion of the permanent magnet which is mechanically coupled to the crank shaft of the internal combustion engine, a voltage is induced within the charging winding. The charging winding is connected to a charging capacitor which stores the energy for ignition. The discharge of the capacitor is controlled by an electronic switch having a control electrode. An auxiliary

winding wound upon the same ferromagnetic core as the charging winding, but in and opposite sense, provides a voltage signal which is opposite in phase to the voltage provided by the charging winding. The output terminal of the auxiliary winding is connected to the control electrode of the electronic switch. When the polarity of the control electrode is such that the electronic switch is turned on, in which case it is in the conductor state, the capacitor discharges through the primary winding of an ignition transformer. The secondary winding of the ignition transformer is applied across the spark plug to be fired by the ignition system. The spark plug can thereby be fired periodically through the motion of the permanent magnet coupled to the internal combustion engine.

The novel features which are considered as characteristic for the invention are set forth in particular in the appended claims. The in particular itself, however, both as to its construction and its method of operation, together with additional objects and advantages thereof, will be best understood from the following description of specific embodiments when read in connection with the accompanying drawing.

BRIEF DESCRIPTION OF THE DRAWING

An electrical schematic diagram showing the electromagnetic and electronic elements and their interconnections for providing ignition impulses to fire spark plugs in internal combustion engines, in accordance with the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Referring to the drawing, the ignition energy is stored in an ignition capacitor **1**. The capacitor is connected to a charging rectifier **2** which, in turn, is connected to the charging winding **3** of a charging coil **4**. the charging coil **4** has a ferromagnetic core **5** which terminates, at its ends, in the pole pieces **6** and **7**. The pole pieces **6** and **7** surround a permanent magnet **8** mechanically coupled to the internal combustion engine (not shown) by means of a mechanical coupling represented by the dash-dot line **9**. The ignition capacitor **1** is also connected to a discharge circuit including the primary winding **10** of an ignition transformer **11**, and an electronic control switch **12**. The latter may, for example, be in the form of a thyristor having a switched path A—K in series with the primary winding **10**. The secondary winding **13** of the ignition transformer **11** is applied across a spark plug **14**.

The control circuit of the electronic switch **12** leads from its control electrode G to its cathode functioning electrode K and to an auxiliary winding **15** on the charging coil **4**. The auxiliary winding **15** provides a control voltage which is opposite in phase or sign to the voltage of the charging winding **3**. The charging winding **3** and auxiliary winding **15** have a common junction P leading to the cathode functioning electrode K of the electronic switch **12**. Extending from the junction P, both windings **3** and **15** are wound oppositely upon the ferromagnetic core **5**.

Fail safe control and operation is achieved by providing the diode **16** in the circuit path between the winding **15** and the control electrode G of the electronic switch **12**. The diode **16** is connected so that its cathode is joined to the control electrode G. For the same reason, a resistor **17** and capacitor **18** are connected across the electrodes G and K of the electronic switch **12**.

In operation, the permanent magnet **8** rotates between the pole pieces **6** and **7** of the ferromagnetic core **5** associated with the charging coil **4**. As a result an AC voltage is induced within the charging winding **3** as well as the auxiliary winding **15**. If half a sine wave appears in the charging winding **3** so that the terminal of the winding connected to the rectifier **2** is positive with respect to the circuit point P, then this voltage signal is transmitted to the ignition capacitor **1** by way of the charging rectifier **2**. The ignition capacitor **1** becomes thereby charged and the energy necessary for the ignition process is stored. To switch the electronic switch **12** into the state where it is conducting along the path A—K, a positive potential with respect to the cathode terminal K is required on the control electrode G. This positive potential for the control electrode is, however, not at that moment available from the auxiliary winding 15. This is because the terminal of the winding 15 connected to the diode 16 is negative with respect to the circuit junction point P. The half sine wave induced within the charging winding 3 can therefore be fully utilized for charging the ignition capacitor 1.

Thereafter the rotating magnet 8 causes a half sine wave to be induced within the charging winding 3, which is negative at the terminal connected to the rectifier 2 with respect to the junction point P. This induced voltage remains ineffective since its polarity is such that the rectifier 2 is in the cutoff state. The ignition capacitor 1 can, therefore, not have the induced voltage applied to it. The half sine wave induced within the auxiliary winding 15, however, can now be applied to the control electrode G, by way of the diode 16. This is because the terminal of the winding connected to the diode 16 is now positive with respect to junction point P. As a result, the control electrode G of the electronic switch 12 becomes positive with respect to the cathode terminal K. The circuit path A—K thereby is switched to the conducting state and the ignition capacitor 1 can discharge through the primary winding 10 of the ignition transformer 11. As a result a high voltage impulse appears in the secondary winding 13 of the ignition transformer 11. This high voltage ignition impulse causes a spark to jump across the electrodes of the spark plug 14.

The charging and discharging process described above in relation to the ignition capacitor 1 is repeated for every ignition process.

The diode 16 leading to the control electrode G of the electronic switch 12 assures that only a positive potential is applied to the control electrode G. As a result the path sine waves induced within the auxiliary coil 15, and not used, do not effect the control path G—K.

With the aid of the resistor 17 connected across the terminals G and K of the electronic switch 12, the magnitude of the control voltage is determined.

The capacitor 18 connected in parallel with the resistor 17 and across the terminal G and K of the electronic switch, serves the purpose of conducting any disturbing oscillations to the cathode so that these oscillations do not influence the control process in an undesired manner.

The present invention of the ignition arrangement has the particular advantage that the control voltage for the electronic switch has a shorter rise time with increase in the speed of the internal combustion engine. As a result automatic advancement of the ignition instant is achieved, which is particularly desirable from the power consumption viewpoint in internal combustion engines.

In the embodiment described above the secondary winding of the ignition transformer includes a single spark plug. It is, however, within the frame of the present invention for the secondary winding to include a plurality of spark plugs. In such an arrangement, the ignition impulse is applied to the plurality of spark plugs, in sequence through the aid of an ignition distributor. The magnetic system can in this case be driven with the corresponding required speed through a transmission means, or can be designed so as to rotate accordingly. In the embodiment disclosed, the magnetic system is comprised of a permanent magnet rotating disc with symmetrical or unsymmetrical distribution of pole pieces, may also be applied. In such a design the magnetic rotating disc rotates about a mounting plate upon which the charging coil is stationarily mounted.

It is also possible in a further embodiment of the invention that the magnetic system is maintained stationary and the charging coil is rotated in the corresponding manner.

A semiconductor control rectifier is used as the electronic switch in the embodiment of the present invention. It is, however, quite possible to use also electronic tubes and other semiconductor elements for this purpose.

It will be understood that each of the elements described above, or two or more together, may also find a useful application in other types of ignition arrangement for internal combustion engines differing from the types described above.

While the invention has been illustrated and described as embodied in ignition arrangement for internal combustion engines, it is not intended to be limited to the details shown, since various modifications and structural structural changes may be made without departing in any way from the spirit of the present invention.

Without further analysis, the foregoing will so fully reveal the gist of the present invention that others can by applying current knowledge readily adapt it for various applications without omitting features that, from the standpoint of prior art, fairly constitute essential characteristics of the generic or specific aspects of this invention and, therefore, such adaptations should and are intended to be comprehended within the meaning and range of equivalence of the following claims.

What is claimed as new and desired to be protected by Letters Patent is set forth in the appended claims.

I claim:

1. An ignition arrangement for an internal combustion engine comprising, in combination, spark plug means to be fired through an ignition impulse applied thereto; ignition capacitor means for storing the ignition energy for firing said spark plug means; charging coil means having a single core with charging winding wound thereon and connected to said ignition capacitor means for charging the same; magnetic means mechanically coupled to said engine and moved by said engine so that the magnetic field of said magnetic means links varyingly with said charging coil means and induces thereby a voltage within said charging winding; electronic switching means connected to said ignition capacitor means and having a control electrode for switching on said switching means into the conducting state to discharge said capacitor means, said discharge of said capacitor being inhibited when said electronic switching means is switched off into the nonconducting state by said control electrode; ignition transformer means having primary and secondary windings, said primary winding being connected to said capacitor means for receiving the electrical discharge therefrom and said secondary winding being connected to said spark plug means; and auxiliary winding means wound on said single core and providing an induced voltage opposite in phase to the voltage within said charging winding, said auxiliary winding being connected to the control electrode of said electronic switching means whereby the discharge of said capacitor means through said primary winding when said switching means is switched to the conducting state by said control electrode induces an ignition impulse in said secondary winding for firing said spark plug means, said electronic switching means being switched to said conducting state by said induced voltage from said auxiliary winding means and applied to the control electrode of said electronic switching means.

2. The ignition arrangement for an internal combustion engine as defined in claim 1 including connecting means for connecting one terminal of said charging winding to one terminal of said auxiliary winding to form an electrical junction connected to said electronic switching means, said charging winding and said auxiliary winding being wound upon said single core in opposite sense.

3. The ignition arrangement for an internal combustion engine as defined in claim 2 including rectifier means connected between said charging winding and said ignition capacitor means.

4. The ignition arrangement for an internal combustion engine as defined in claim 3 including diode means connected between said auxiliary winding and said control electrode of said electronic switching means.

5. The ignition arrangement for an internal combustion engine as defined in claim 4 including input and output terminal means on said electronic switching means; and resistor means connected in parallel with said control electrode and one of said terminal means.

6. The ignition arrangement for an internal combustion engine as defined in claim 5 including auxiliary capacitor means connected in parallel with said resistor means.

7. The ignition arrangement for an internal combustion engine as defined in claim 1 wherein said electronic switching means is a semiconductor controlled rectifier.

8. The ignition arrangement for an internal combustion combustion engine as defined in claim 1 including mechanical coupling means for coupling said magnetic means to the crank shaft of said internal combustion engine.

9. The ignition arrangement for an internal combustion engine as defined in claim 8 wherein said magnetic means comprises a permanent magnet rotated by the crank shaft of said engine.

10. The ignition arrangement for an internal combustion engine as defined in claim 1, wherein said single core has magnetic pole pieces surrounding said magnetic means, so that the reluctance of the magnetic circuit through said charging coil means is varied through the motion of said magnetic means.