ISSN: 2278 – 909X
International Journal of Advanced Research in Electronics and Communication Engineering (IJARECE)
Volume 6, Issue 12, December 2017

Capacitive Discharge Ignition for Two Wheelers

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Abstract: **--In order to increase the engine power, economy and improve the pollution emissions, a new smart ignition system is proposed. Through a programmable and controllable ignition angle technique to improve the ignition efficiency for the DC capacitive discharge ignition (CDI) system. The 8-bit single chip microcomputer is implemented to read the crankshaft speed signal and camshaft baseline signal. The ignition angle of the engine can be controlled by the preloaded engine power characteristic curve and the intelligent determination made by the microcomputer. From the full scale vehicle testing results of the prototype system, the proposed ignition system exhibits much better performance than present traditional ones in engine power curve, friendliness of human-machine interface and ease of use.**

Index Terms- Capacitive Discharge Ignition for motorcycle, CDI

I. Introduction

In the world of small motor, such as mopeds or lawn movers the ignition system design is based exclusively on CDI. Now a days, due to new standards of pollution control, the CDI system is becoming one of the most efficient choice available. This paper is over view of the behaviour of the CDI, the solutions propose today in two wheeler motor applications and the state of the art in automotive.

II. CDI PRINCIPLE

To ignite the air and petrol mixture in the combustion chamber is produced by the CDI module, spark is necessary. This system consists of 7 stages.

A. HV Supply

The HV supply differs from small motors to automobiles. The small 1 or 2 cylinder motors 1 or 2 stroke have a fly-wheel which have a supply winding. After the rectification positive voltage variable between 100 and 400V produces by such coil sensor.
The HV for an automobile CDI is supplied by a DC/DC converter. This stage produces generally 400V from the 12V battery voltage.

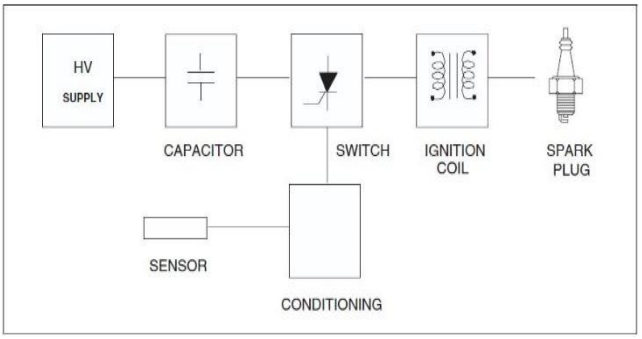

Fig 1:- Block Diagram

B. Capacitor

Previously capacitor between 0.46 and 2µF are used, to store the charge from the HV supply. The capacitor is discharged through the ignition circuit during the second phase of the ignition cycle.

C. Switch

The switch is used to transfers the energy stored in the capacitor to primary of the ignition coil. This function is carried out by a SCR or a triac. For the reverse current the switch is generally linked to a diode.

D. Sensor

The goal of the sensor is to synchronize the spark with the engine rotation. For the two wheelers motor the sensor detects a bump at each engine revolution.

E. Conditioning

The conditioning is a very important stage which must assume the following functions:

- The SCR gate current can be optimised for all the RPM range.
- Parasitic strikes happening on the sensor signal can be characterised.
- For the most advanced two wheeler engine and all the car systems, it has to ensure the correct lead angle.

This stage is realized using few passive components for two wheelers motor modules, while a microprocessor is needed for automotive management systems.

F. Ignition coil

Ignition coil is a step-up transformer which deliver high voltage to spark plug. This value can be between 5kV and 20kV depending on working conditions.

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G. Spark plug

Spark plug is the last element of ignition chain. Good spark quality is linked to a High engine efficiency and a complete gas combustion.Minimum of 20 milli-joules is necessary at spark plug.

III. HOW DOES IT WORK?

Two different topologies are possible.

A. First topology

When spark is needed a current Ig is injected to the SCR gate which then fires the SCR. The capacitor discharge which generates an alternative current is initiated due to The SCR firing. The SCR conducts during all the positive phases of the discharge current while the diode D acts for the negative parts.

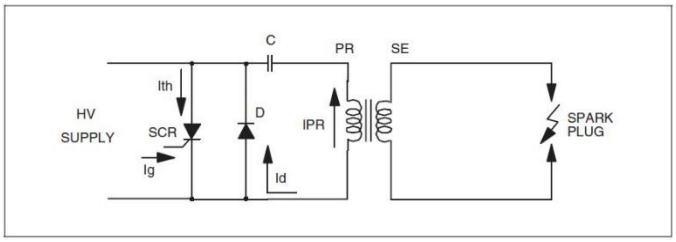

Fig 2:- The first possibility of discharge circuit

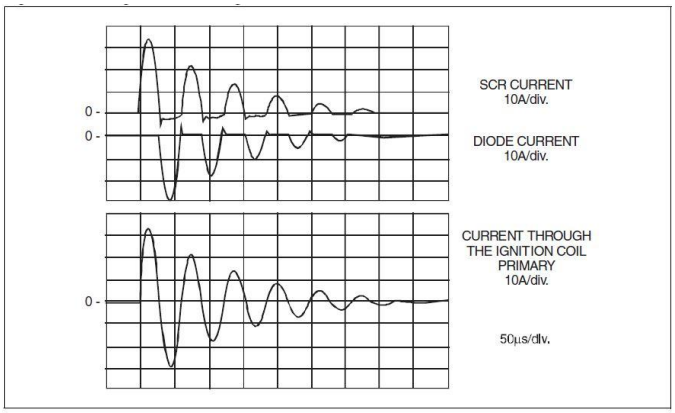

Fig 3:- Discharge current through the circuit

B. Second topology

The topology shown in fig 4 the SCR acts during the 1st part of the current cycle until the capacitor voltage reverse.
Then the freewheeling diode D conducts as long as there is energy remaining on the primary coil.

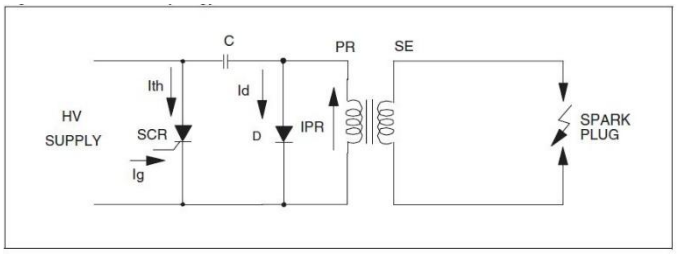

Fig 4:- The second possibility of discharge circuit

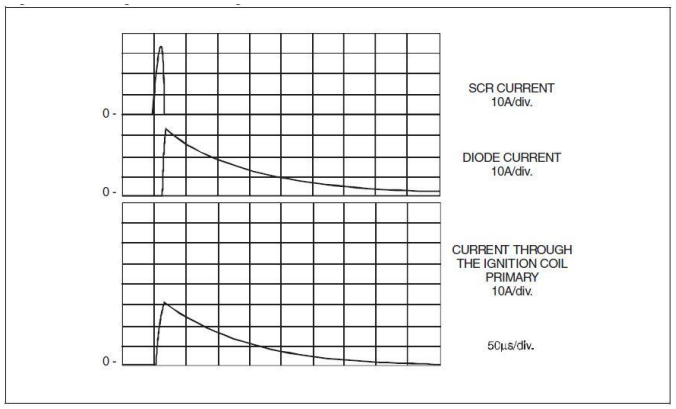

Fig 5:- Discharge current through the circuit

IV. SMALL ENGINE SYSTEM

Fig 6 shows the topology is chosen for the small motor CDI module.
The supply coil produce an alternating voltage, in which the positive parts are rectified by D2 and the negative parts are clamped by D3. Previously designer uses 1000V for diode D2 and D3 due to the circuit shown in fig 6 designer can use 400V for these diodes and the capacitance C1 is loaded by the positive rectified current.

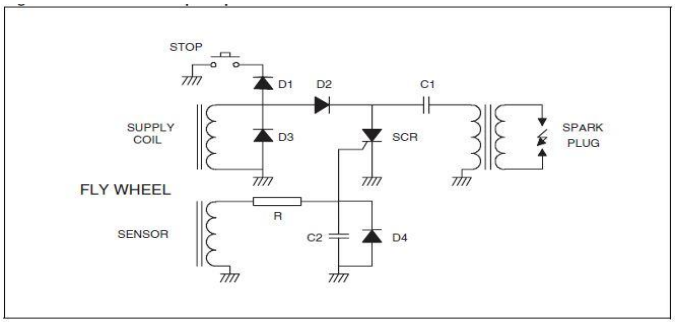

Fig 6:- Two wheelers DCI principle circuit

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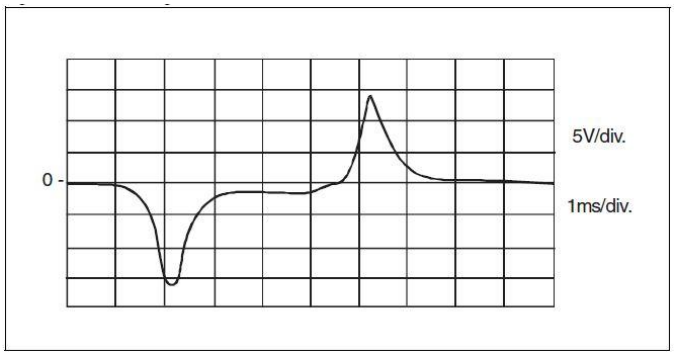

Fig 7:- Sensor coil signal

V. SENSOR COIL APPLICATION NOTE

At each engine revolution a signal as shown in Figure 7 generated by the sensor coil.
The negative part of this signal is clamped by D4 while the positive part produces a current through the gate, firing the SCR.
Due to parasitic voltage occurring on the sensor signal this paper suggest the use of the conditioning stage as per in fig 8.
This gate drive circuit, using R1 between 1 and 10kΩ and C1 between 1 and 10µF allows the SCR to run Without problems of parasitic firing.

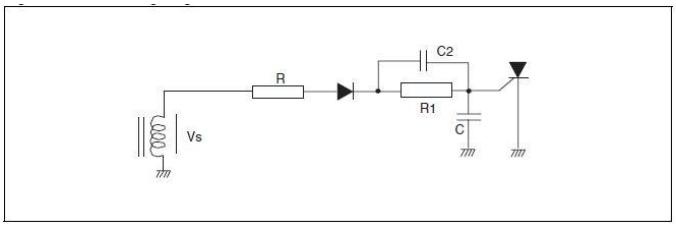

Fig 8:- Conditioning stage

VI. TWO WHEELER SMALL MOTOR APPLICATION CIRCUIT

Same application circuit using ICC01 and ICC03 is shown in the fig 9 and fig 10. In both cases the conditioning stage limits the current through the gate, its maximum value being calculated as follows:
R max = (VS min - VGT max) / 2 IGT max
withVs = sensor voltage.

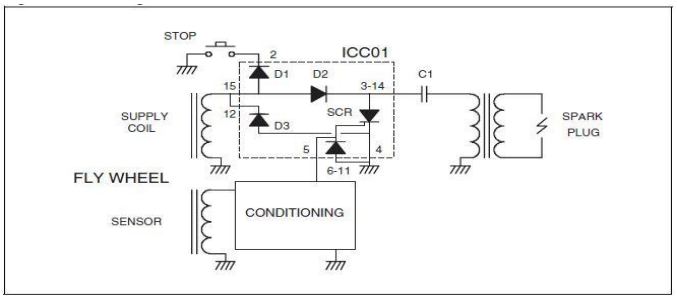

Fig 9:- CDI using ICC03

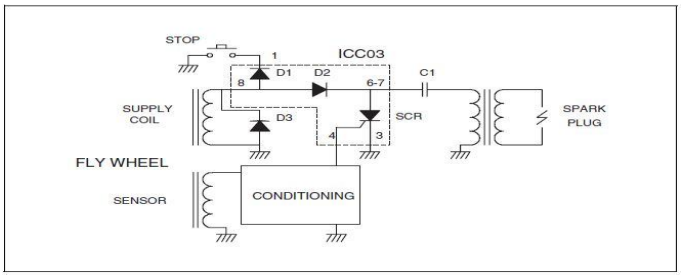

Fig 10:- CDI using ICC01

VII. Conclusion

Capacitive discharge ignition systems are the only choice for the two wheelers. They are also found frequently in racing car engine management computer. For the future the CDI could be the solution meet the new anti-pollution standard requirements.

VIII. Acknowledgements

We are grateful to DEPARTMENT OF ELECTRONICS ENGGINERING, VISHWAKARMA INSTITUTE OF

TECHNOLOGY, PUNE for having provided us with the facilities needed for the successful completion of this Survey paper. .

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